



# **NIGHTTIME CONSTRUCTION NOISE VARIANCE APPLICATION**

***Sound Transit Central Link Light Rail  
Beacon Hill Tunnel and Station Contract***

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## TABLE OF CONTENTS

<b>1.0</b>	<b>INTRODUCTION</b> .....	<b>1-1</b>
<b>2.0</b>	<b>EXISTING NOISE LEVELS</b> .....	<b>2-1</b>
<b>3.0</b>	<b>CONSTRUCTION ACTIVITIES</b> .....	<b>3-1</b>
<b>3.1</b>	<b>Description of Construction Work</b> .....	<b>3-1</b>
<b>4.0</b>	<b>CONSTRUCTION NOISE LIMITS</b> .....	<b>4-1</b>
<b>4.1</b>	<b>City of Seattle Noise Ordinance</b> .....	<b>4-1</b>
<b>4.2</b>	<b>Nighttime Noise Limits</b> .....	<b>4-2</b>
<b>4.3</b>	<b>Nighttime Construction Noise Estimates</b> .....	<b>4-4</b>
<b>5.0</b>	<b>CONTRACTOR REQUIREMENTS</b> .....	<b>5-1</b>
<b>5.1</b>	<b>Nighttime Construction Noise Level Limits</b> .....	<b>5-1</b>
<b>5.2</b>	<b>Mandatory Noise Control Measures</b> .....	<b>5-1</b>
<b>5.3</b>	<b>Specifications</b> .....	<b>5-4</b>
<b>5.4</b>	<b>Acoustical Engineer</b> .....	<b>5-4</b>
<b>5.5</b>	<b>Noise Control Plan Guidelines</b> .....	<b>5-4</b>
<b>5.6</b>	<b>Noise Monitoring Plan Guidelines</b> .....	<b>5-5</b>
<b>5.7</b>	<b>Discretionary Noise Control Measures</b> .....	<b>5-5</b>
<b>6.0</b>	<b>CITIZEN INVOLVEMENT AND PUBLIC COMPLAINT RESOLUTION</b> .....	<b>6-1</b>
<b>6.1</b>	<b>Public Information</b> .....	<b>6-1</b>
<b>6.2</b>	<b>Public Complaint Coordination</b> .....	<b>6-1</b>
<b>6.3</b>	<b>Evaluation</b> .....	<b>6-1</b>
<b>6.4</b>	<b>Documentation</b> .....	<b>6-1</b>
<b>6.5</b>	<b>Construction Hotline Procedures</b> .....	<b>6-1</b>

**APPENDIX A - Existing 24-Hour Noise Measurements**

**APPENDIX B - Construction Noise and Vibration Control Specification**

## LIST OF TABLES

2-1	Nighttime Hourly Noise Measurements.....	2-3
3-1	Beacon Hill Tunnel Above Ground Nighttime Construction Activities .....	3-6
4-1	Seattle Noise Ordinance Maximum Permissible Sound Levels .....	4-2
4-2	Sliding Scale Criteria for Nighttime Noise Level Increase.....	4-3
4-3	Nighttime Construction Noise Level Limits.....	4-4
4-4	Estimated Nighttime Construction Noise at West Portal Site .....	4-5
4-5	Estimated Nighttime Construction Noise at Beacon Hill Station Site .....	4-6
4-6	Estimated Nighttime Construction Noise at East Portal Site.....	4-7
5-1	Maximum Permitted Noise Emissions for Construction Equipment Used During Nighttime Hours .....	5-3

## LIST OF FIGURES

2-1	Noise Measurement Locations.....	2-5
3-1	West Portal Construction Site .....	3-2
3-2	Beacon Hill Station Construction Site .....	3-3
3-3	East Portal Construction Site .....	3-4

## **1.0 INTRODUCTION**

Sound Transit is seeking a variance from the City of Seattle's Noise Ordinance to allow for certain construction activities and the operation of construction equipment during the nighttime hours for the Beacon Hill Tunnel and Station Contract. The Beacon Hill Tunnel corridor of the light rail project extends from the west of Airport Way South near its intersection with S. Forest Street to the east of 26th Avenue South near its intersection with S. McClellan Street. The variance would permit certain construction activities during nighttime hours from 10 p.m. to 7 a.m. on weekdays, 10 p.m. to 9 a.m. on weekends, and holidays. Sound Transit needs a variance from the nighttime noise limits of the Administrative Code of the City of Seattle (Ordinance 102228), Chapter 25.08, Noise Control, Section 25.08.425 (the Seattle Noise Ordinance) in order to allow tunnel construction to proceed.

Sound Transit is proposing a three-pronged approach to control nighttime construction noise levels. First, the intent of the construction noise limits is to provide performance criteria that the Contractor will not exceed during nighttime hours. These criteria give the Contractor the flexibility of either prohibiting certain noise generating activities during nighttime hours or providing additional noise control measures such as temporary noise barriers, noise curtains, noise tents, or the use of quieter equipment to meet these noise limits. Second, the mandatory noise control measures and precautions will be required at every construction site and will be in place before any construction operations begin. Third, citizens will provide oversight as discussed in Section 6.0 of this report.

Tunnels for Beacon Hill Station will be excavated through soils and perched water tables, working from the station shafts located on the Beacon Hill Avenue-Lander Street construction staging area. This tunnel and shaft construction must be carried out by Sequential Excavation Method (SEM) mining, and must be conducted on a continuous 24 hours-a-day, 7 days-a-week basis, in order for the ground to be excavated and supported in a way to maximize safety of the works and of the workforce, and to minimize surface settlements. The running tunnels to be excavated by Tunnel Boring Machine (TBM) from west to east through the soils of Beacon Hill from a staging area west of I-5, also need to be constructed on a 24-hour basis, not only for purposes of economy but also to minimize surface settlements, most probably with one week-end day stopped for necessary machine maintenance. As a secondary benefit, granting the variance will permit the project to be completed more quickly, reducing the overall construction time and associated impacts. Conditions imposed as part of the variance process will ensure that the public and those likely to be affected by the noise will be appropriately protected, and that noise impacts will be minimized. Many of these noise control conditions will also provide noise reduction benefits during all hours of construction.

Sound Transit's application for a technical variance includes a detailed "Construction Noise Control and Monitoring Plan" (the Plan). The Plan includes prescriptive specifications for noise control at applicable construction sites. The noise specifications contained in the Plan are based on nighttime noise level limits developed from existing noise monitoring. Specific noise control measures will be required at each construction site. These measures will help ensure that the Contractor will comply with the nighttime noise level limits established in the variance, given all of the planned construction activities. The noise level limits included in the Plan provide that on average (on an hourly basis) noise levels will be no more than 5 dBA over existing noise levels. The Plan includes specific noise control measures such as noise walls, portable sound barriers, quiet equipment and other measures. The Plan also includes monitoring and enforcement mechanisms to ensure that the noise specifications and requirements of the variance are met.

This Noise Control and Monitoring Plan provides information to the City of Seattle's Department of Design Construction and Land Use (DCLU) and the public in support of the variance, including:

- Noise sensitive land uses that would be affected during nighttime construction activities.

- Measured existing noise levels at each of the construction sites.
- Allowable nighttime noise limits based on the existing ambient noise at each construction site.
- Description of the activities that would occur and equipment that would be used at each construction site during different types of major construction activities.
- Measures to enforce and monitor the Contractor's activities during the life of the Project.
- Measures to control and minimize potential noise and vibration impacts that would be specified in the Contract.
- Program for public complaint monitoring and resolution for Sound Transit and the Contractor.

### **Type of Variance Requested**

Sound Transit requests a technical variance for nighttime noise during construction of the Beacon Hill Tunnel and Station of the Central Link Light Rail Project (the Project). The variance would apply to construction activities weekdays between the hours of 10 p.m. and 7 a.m. and weekends between the hours of 10 p.m. and 9 a.m. This application for a variance is made pursuant to Seattle Municipal Code (SMC) sections 25.08.560 through .650. Daytime construction activities are not subject to this variance.

A technical variance is available under the Seattle Municipal Code where the applicant demonstrates that the noise will not "endanger public health or safety" and where i) there are "no practical means known or means available for the adequate prevention, abatement or control of the noise involved"; and ii) "alternative measures" for controlling noise will be undertaken. The materials that follow and the attachments include the required demonstrations and detailed alternative measures for controlling noise. A public hearing is required, following appropriate public notice, before a technical variance may be granted by the City of Seattle's Department of Construction and Land Use.

### **Extent and Duration of Variance**

Sound Transit is applying for a variance to cover all aboveground, nighttime construction activities occurring as part of the Beacon Hill Tunnel and Station Contract at the following construction sites:

West Portal  
Beacon Hill Station  
East Portal

Nighttime utility relocation work occurring outside the limits of the construction sites listed above would not be covered by this technical variance. Temporary variances will be separately obtained where needed for this off-site work, by the different contractors performing the work. Maps showing the location of the three construction staging areas and their immediate surroundings and work and activities to be conducted at each location are included with this report. Contractors to Sound Transit, the City of Seattle, public and private utilities, or other project participants may perform nighttime construction work if the work is performed within the construction sites covered by this technical variance application.

The variance would be in effect for the duration of the construction activity for the Beacon Hill Tunnel and Station Contract. According to draft project construction schedules, construction will extend from approximately 2004 until 2008.

### **Public Benefits**

The prime benefit of constructing the tunnels on a continuous 24 hours-a-day basis is to allow excavation and support of the tunnels in the safest way practical, and to minimize surface settlements and potential resulting damage to the built environment. Specifically, the variance to the noise ordinance is required to

allow the necessary surface-level support work for the continuous underground tunneling operations. However, an additional benefit is that the continuous tunneling operations will result in earlier completion of the Project which will also bring major public transportation and other benefits to all of the populations it serves. These benefits are described in the Central Link Light Rail Project Final Environmental Impact Statement, published November 1999. The sooner the Project is completed, the sooner these benefits are available to the public.

The variance will also save substantial construction time by allowing for nighttime work. Saving time produces certain benefits, including:

*Substantial cost savings for the public.* A shorter construction period has clear effects on costs: reduced administrative expenses, reduced length of construction time needed for equipment and personnel, and savings on the inflation that would otherwise compound the cost of construction in later years.

*Reduction of overall construction inconvenience.* The variance would allow for a condensed construction schedule, which would not only lessen duration of construction impacts but other associated environmental impacts such as noise on nearby residents, businesses, and other affected entities.

*Reduction of certain disruptions associated with peak-hour daytime work.* With a variance, some of this work can be shifted to off-peak hours, reducing overall impacts.

In addition, the noise control mitigation measures established for nighttime construction activities will also provide a direct benefit to the public and adjacent property owners by reducing the overall level of construction noise coming from the three construction worksites. The mitigation measures proposed, such as noise barrier walls and quiet equipment, will be in place 24 hours/day, not just during nighttime hours. This is a benefit that would not otherwise be obtained without the variance.

### **No Endangerment to Public Health and Safety**

Before granting a variance, the City must determine that the noise levels allowed by the variance will not endanger public health and safety. The nighttime noise levels allowed by the variance will be below the Occupational Safety and Health Act (OSHA) limit of 90 dBA for hearing damage, and under 85 dBA, the threshold of risk for potential hearing loss identified by U.S. Environmental Protection Agency. As described in the Noise Control and Monitoring Plan, the nighttime noise level limits are lower than 68 dBA, well below the threshold of federal concern.

## 2.0 EXISTING NOISE LEVELS

The object of measuring existing noise levels is twofold. First, the measurements provide baseline information, which is required in establishing the noise environment to which the various communities are currently exposed. Second, existing noise level measurements are used as a baseline against which the construction-generated noise will be assessed. The existing noise levels are due primarily to traffic on nearby local streets and the I-5 Freeway. In the Beacon Hill Station area of the project the aircraft flyovers from Sea Tac Airport and Boeing Field are also part of the existing noise levels.

Existing ambient noise levels were measured at 16 sites identified as representative nighttime noise sensitive land uses close to each construction site during the period of July 26 through August 21, 2002 and January 8 through 11, 2003. At Sites BH 1, BH 4, BH 6 and BH-9 seven days of 24-hour measurements were conducted. At Sites WP 1, EP 1, EP 3 and EP 4, 24-hour measurements were conducted for one weekday period. At the remaining sites, short-term noise measurements were sampled during the nighttime hours of 10 p.m. to 7 a.m. Land uses at these sites include single and multi-family residential, and a community center.

The selected noise measurement sites at each of the three construction sites are described below and are shown on Figure 2-1.

### West Portal Construction Site

**Site WP 1** 2917 12<sup>th</sup> Avenue at Seaview Park – Closest single-family residence to the west portal located to the east and about 100 feet above the west portal. Measurement was taken on west fence line at Seaview Park.

### Beacon Hill Station Construction Site

**Site BH 1** El Centro: Jose Marti Child Development Center – Three story building located to the north of the construction site. Measurement was taken outside of a second floor office window facing the construction site.

**Site BH 2** 2608 17<sup>th</sup> Avenue – One story single-family residence between Waite and Landers Streets, northeast of the construction site. Measurement was taken at the setback of the house along the side yard of the property.

**Site BH 3** 2702 17<sup>th</sup> Avenue – One story single-family residence between Landers and McClellan Streets, east of the construction site. Measurement was taken at the setback of the house along the side yard of the property.

**Site BH 4** 2802 17<sup>th</sup> Avenue – One story single-family residence at the corner of McClellan Street and 17<sup>th</sup> Avenue, southeast of the construction site. Measurement was taken on front porch.

**Site BH 5** 2820 17<sup>th</sup> Avenue – One story single-family residence at the corner of Forest Street and 17<sup>th</sup> Avenue, southeast of the construction site. Measurement was taken at the setback of the house along the side yard of the property.

**Site BH 6** Laura Apartments, 2610 16<sup>th</sup> Avenue – Three story apartment building located to the south of the construction site. Measurements were taken at second floor windows.

**Site BH 7** 2817 16<sup>th</sup> Avenue – One story single-family residence between McClellan and Forest Streets, southwest of the construction site. Measurement was taken at the setback of the house along the side yard of the property.

- Site BH 8** 2801 16<sup>th</sup> Avenue – One story single-family residence at the corner of McClellan Street and 16<sup>th</sup> Avenue, southeast of the construction site. Measurement was taken at the setback of the house along the side yard of the property.
- Site BH 9** Lander Apartments, 2541 15<sup>th</sup> Avenue – Two story apartment building located to the west of the construction site. Measurement was taken out of second floor window in the center of the building.
- Site BH 10** 2538 Beacon Avenue – One story single-family residence northwest of the construction site. Measurement was taken at the rear of the property along 16<sup>th</sup> Avenue.

**East Portal Construction Site**

- Site EP 1** 3029 25<sup>th</sup> Avenue – Closest single-family residence located to the south of the east portal located near McClellan Street. Measurement was taken by the green preservation area on the north property line.
- Site EP 2** 2721 25th Avenue – Single-family residence located just north of Stevens Street..
- Site EP 3** Mt. Baker Village Apartments, 2569 29<sup>th</sup> Avenue S. – Four Story apartment building located to the west of the construction site (west of Martin Luther King Jr Way South). Measurement was taken from the roof at the Southeast corner of the building.
- Site EP 4** 2905 McClellan St. – Single-family residence located to the west of the construction site (west of Martin Luther King Jr Way South). Measurement was taken from the front porch of the home, four feet from the front door facing McClellan St.
- Site EP 5** 2707 30<sup>th</sup> Avenue S. – Single-family residence located west of the construction site. Measurement was taken on the sidewalk in front of the home along 30<sup>th</sup> Avenue.

The measured hourly noise levels data during the weekday nighttime hours of 10 p.m. to 7 a.m. are presented in Table 2-1. All of the 24-hour measurement data is presented in Appendix A.



**Table 2-1**  
**Nighttime Hourly Noise Measurements – Leq (dBA)**

	Date	10 p.m. to 11 p.m.	11 p.m. to 12 midnight	12 midnight to 1 a.m.	1 a.m. to 2 a.m.	2 a.m. to 3 a.m.	3 a.m. to 4 a.m.	4 a.m. to 5 a.m.	5 a.m. to 6 a.m.	6 a.m. to 7 a.m.
<b>WEST PORTAL CONSTRUCTION SITE</b>										
WP 1	02Aug to 03Aug 02	67.4	66.9	65.6	64	63.5	61.9	62.6	64.4	66.3
<b>BEACON HILL STATION CONSTRUCTION SITE</b>										
BH 1	26Jul to 27Jul 02	60.7	58.6	55.2	56.9	56.6	60.5	60.8	58.9	58.7
	27Jul to 28Jul 02	61.4	58.8	51.2	54.9	53.6	55.6	58	57.1	60.4
	28Jul to 29Jul 02	58.8	58.8	57.5	57.6	60.4	60.8	59.5	60.3	61
	29Jul to 30Jul 02	54	54.4	54.1	43.1	46.8	52.3	55.8	55.6	58
	30Jul to 31Jul 02	53.9	54.6	49.7	49.4	47.6	55.5	59.1	57.9	57.3
	31Jul to 01Aug 02	55	53.8	51.7	49.5	43.3	56.6	52.1	61.6	60.7
	01Aug to 02Aug 02	56.7	56	53.6	46.1	53.8	61.1	59.8	61.4	59.3
BH 2	30Jul 02	58.1	57.1	58.3	56.1	59.7	59.2	58.1	60.1	62.1
BH 3	30Jul 02	60.4	61.1	59.9	58.5	61.3	59.3	59.6	59.5	62.3
BH 4	07Aug to 08Aug 02	61.5	61	60.2	60	58.4	59.5	60.6	63.7	64.5
	08Aug to 09Aug 02	62.1	59.8	60.5	60.2	59.8	61.3	60.8	64.5	65
	09Aug to 10Aug 02	60.9	60.6	58.8	58.9	62.2	59.4	60.3	60.1	61.1
	10Aug to 11Aug 02	61.4	60.1	59.4	58	62	59	59.7	59.5	60.8
	15Aug to 16Aug 02	58.7	57.5	58.5	56.4	60.5	59.5	58.7	60	62.2
	18Aug to 19Aug 02	58.8	57.9	56.6	56.8	56.9	58.1	58.5	60.4	63
	20Aug to 21Aug 02	65	64.4	65.2	66.2	63	62.5	63.3	64.9	65
BH 5	30Jul 02	62.9	60.5	61.1	61.2	60.9	62.5	61.6	65.3	65.2

**Table 2-1 (Cont'd)**  
**Nighttime Hourly Noise Measurements – Leq (dBA)**

	Date	10 p.m. to 11 p.m.	11 p.m. to 12 midnight	12 midnight to 1 a.m.	1 a.m. to 2 a.m.	2 a.m. to 3 a.m.	3 a.m. to 4 a.m.	4 a.m. to 5 a.m.	5 a.m. to 6 a.m.	6 a.m. to 7 a.m.
<b>BEACON HILL STATION CONSTRUCTION SITE</b>										
BH 6	26Jul to 27Jul 02	62	62.2	60.9	61.6	60.1	59.3	62.1	61.9	63.2
	27Jul to 28Jul 02	61.7	59.7	59.5	61.9	59.3	56	60	65.4	68.3
	28Jul to 29Jul 02	62.7	62	61.4	59	64.1	65.1	63.6	64.6	66.3
	29Jul to 30Jul 02	61.7	60.4	59.3	55.3	53.3	58	62.3	64.4	66.5
	30Jul to 31Jul 02	61.8	60.7	57.9	58.9	54.8	59.8	61	62.8	65.7
	31Jul to 01Aug 02	61.5	58.3	57.9	55.3	53.6	57.6	56.9	64.7	66.1
	01Aug to 02Aug 02	63.7	61.4	58.7	55	59.7	63.5	63.2	64.3	65.4
BH 7	30Jul 02	55.1	54.7	53.3	51.3	55.1	58.4	58.7	59.1	60.5
BH 8	30Jul 02	57.3	55.2	54.9	53.3	56.5	59.6	59.3	60.4	61.2
BH 9	07Aug to 08Aug 02	64.3	62.6	58.2	58.8	57.8	56.5	61	70.1	68.1
	08Aug to 09Aug 02	62.4	61.5	59.6	58.3	56.4	59	60.1	66.3	67.4
	09Aug to 10Aug 02	66	64.6	61.5	61.6	58.1	56.8	59.4	61.1	61.9
	15Aug to 16Aug 02	61.8	61.2	58.3	56.9	57.4	60.2	61.7	64.2	69.3
	18Aug to 19Aug 02	61	60.1	58.4	57.8	54.4	58.4	60.3	64.9	66.4
	20Aug to 21Aug 02	63.3	61	58.1	58.6	55.1	57.7	62.2	65.7	66
BH 10	30Jul 02	60.5	60.1	59.3	58.9	61.7	60.1	60.9	62.1	63.5
<b>EAST PORTAL CONSTRUCTION SITE</b>										
EP 1	01Aug to 02Aug 02	55.4	54.3	51	49.8	47.7	48.6	49.8	52	54.6
EP 2	30Jul 02	55.9	55.1	51.7	50.9	48.6	49.9	51	52.5	55.8
EP 3	10Jan03 to 11Jan03	69.1	68.2	67.6	67.3	67.7	68.1	67.5	60	61.2
EP 4	8Jan03 to 9Jan03	60.1	60.3	56.3	57.8	55.8	54.8	58.2	59.7	62.2
	9Jan03 to 10Jan03	60.4	57.9	56.2	54.1	54.4	51.5	55.4	57.1	61.9
EP 5	6Jan03 to 9Jan03	55.1	52.9	51.2	49.1	49.3	46.5	50.4	52.1	56.9

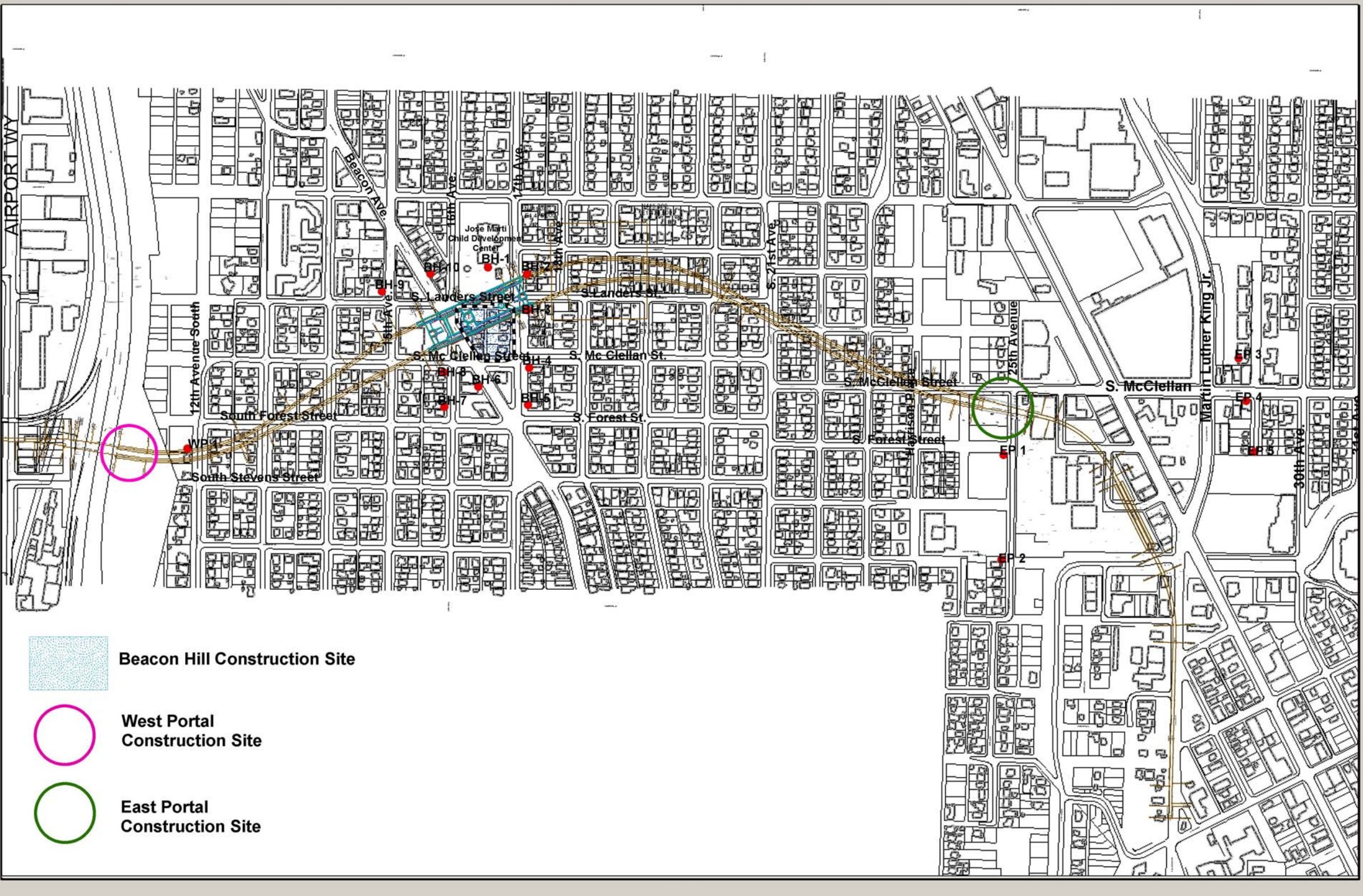


Figure 2-1 – Noise Measurement Locations



### **3.0 CONSTRUCTION ACTIVITIES**

#### **3.1 Description of Construction Work**

Construction of the Beacon Hill Station large-sized tunnels, shafts and complex tunnel/shaft intersections will be carried out through soil and perched water tables by Sequential Excavation Method (SEM) mining working from the station shafts. This work must be conducted on a 24 hours-a-day, 7 days-a-week basis in order for the faces of the mined excavations to be advanced in a continuous sequence, allowing the soils to be excavated and the ground supported in a way to maximize safety of the works and of the workforce, and to minimize surface settlements and potential damage to the built environment. Although noise generated by the SEM underground mining operations should not be noticeable at the surface, surface support operations for the underground construction will require use of noise-producing heavy equipment, necessitating a variance to the City noise ordinance.

Construction of the Beacon Hill Running Tunnels will be by tunnel boring machine (TBM). Tunnel mining operations will occur around-the-clock, 7-days a week, using multiple-shifts of workers. A portion of each workweek is set-aside for regular equipment maintenance and repair. Constant work is necessary to meet the changing conditions typically encountered with tunnel construction, to regularly advance the tunnel progress, to minimize surface settlements, to maximize the contractor's investment in specialized equipment and its use, to minimize unforeseen delays and meet the Project schedule, and to promote safety through regular, assembly-line type work.

While much of the underground work will occur unnoticed by the public, there will be three major construction activity centers from which all tunnel construction and staging work will occur. These three activity centers for all tunneling activity are the west and east tunnel portals and the Beacon Hill station area. The proposed layout of each of these construction sites is presented on Figures 3-1 through 3-3. Most of the earth excavated for the running tunnels and material used to construct the running tunnels, along with rolling stock and workers used during the construction will pass through the west portal. Nighttime activities at the other two construction areas will support the tunneling operations.

Work at these construction locations cannot be performed without noise-producing heavy equipment, such as backhoes, bulldozers, muck trains, cranes, concrete mixers and batch plants, dump trucks and loaders, as well as smaller equipment, such as air compressors, electrical generators, and ventilation fans. Operation of this type of equipment during daytime hours (7 am to 10 pm weekdays and 9 am to 10 pm on weekends) is generally permitted under the City of Seattle's Noise Ordinance, subject to some specific limitations. However, operation of such equipment during nighttime hours requires a variance from the City's noise code.

#### **West Portal Construction Site**

At the West Portal site all construction activities and other construction support functions will be performed 24-hours a day. The major construction activities that are expected to occur at the West Portal site during the nighttime hours are as follows:

- earthwork and concrete construction;
- assembly of tunnel boring machine;
- removal of excavation spoils from tunnel by muck train;
- supply of precast tunnel segments to tunnel;
- loading of excavation spoils on to trucks or rail cars for transport to disposal site;
- trucks and trains entering and leaving construction site;
- continuous operation of ventilation fans, air compressors, dewatering pumps, and diesel electric generators; and
- unloading of materials delivered by truck or train.



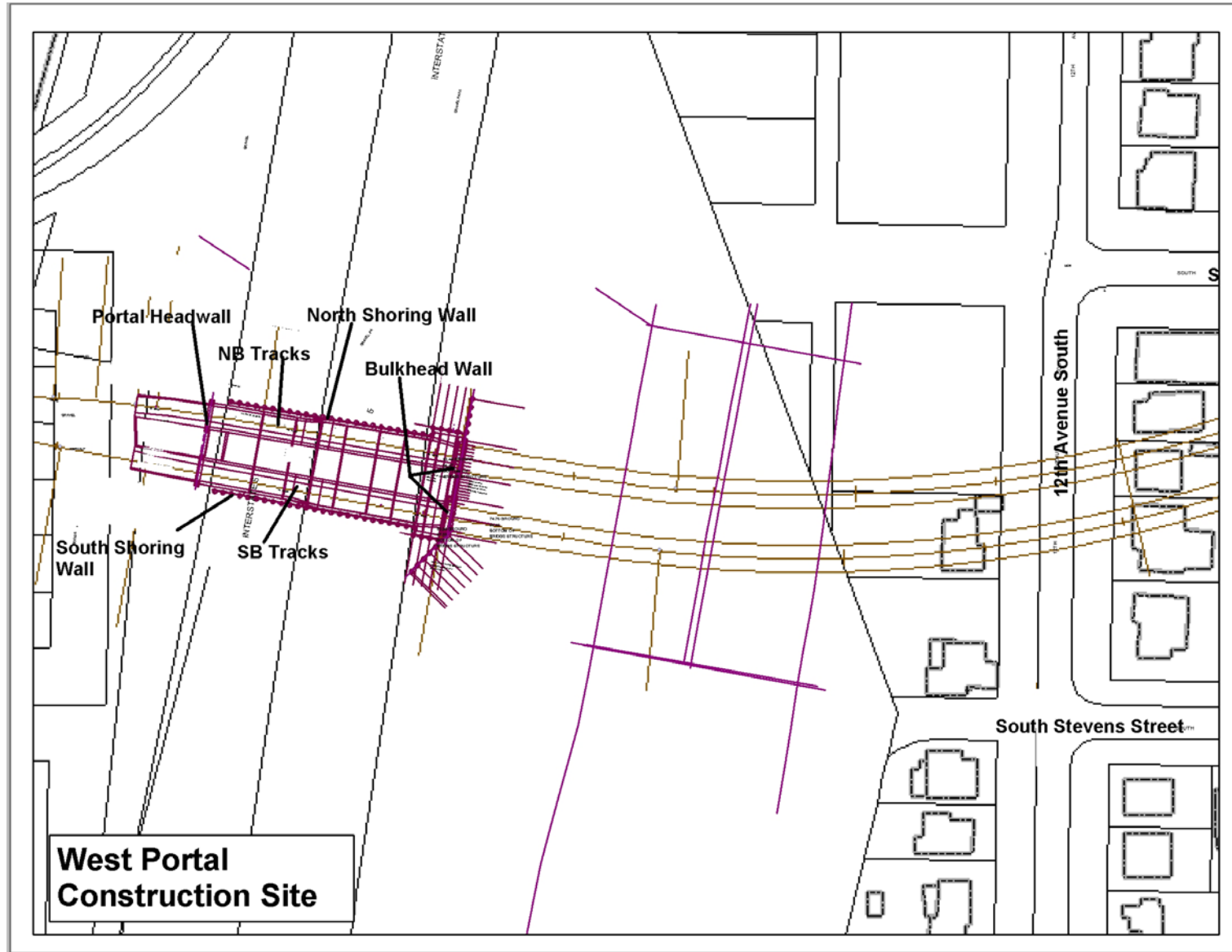


Figure 3-1 – West Portal Construction Site

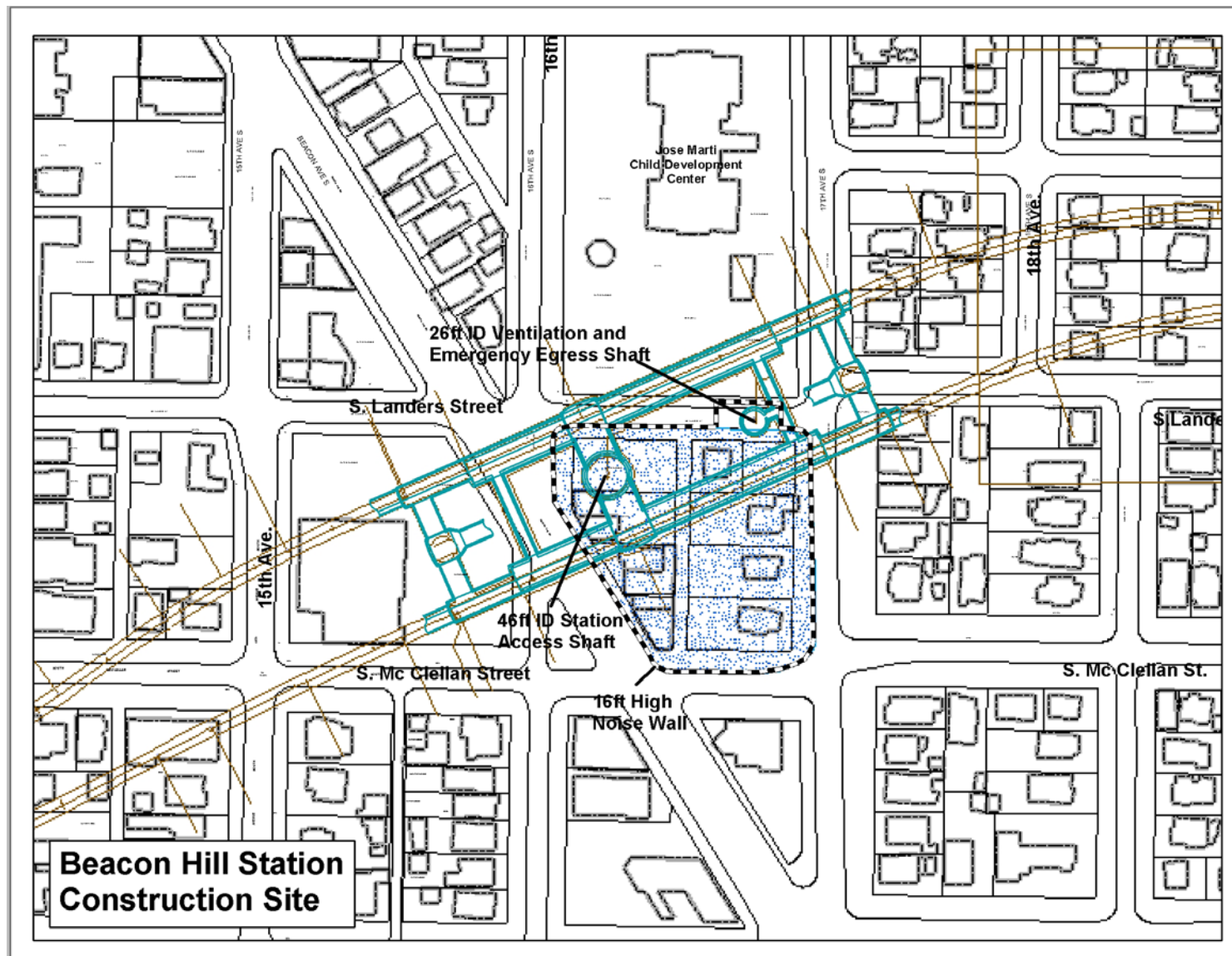


Figure 3-2 – Beacon Hill Station Construction Site

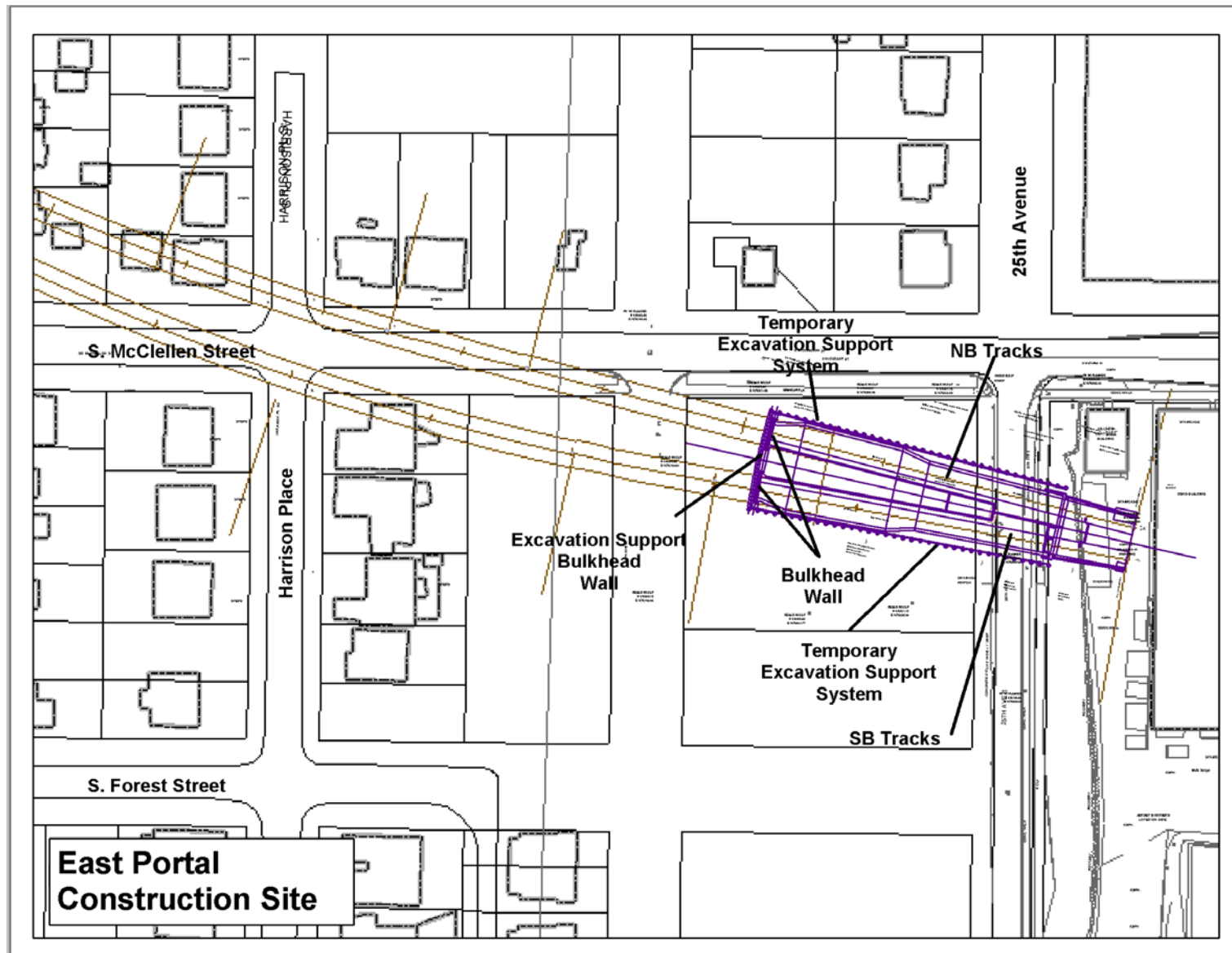


Figure 3-3 – East Portal Construction Site



### **Beacon Hill Station Construction Site**

At the Beacon Hill Station site, demolition of existing surface buildings and construction of headhouse aboveground structures will be performed during daytime hours. Excavation and construction of the elevator and ventilation shafts, underground station tunnels and station below-ground structures will be performed 24-hours a day. The major construction activities that are expected to occur at the Beacon Hill Station site during the nighttime hours are as follows:

- underground shaft, station, and tunnel excavation and concrete construction;
- hoisting of spoils from station excavation up through the elevator shaft by crane lifted bucket;
- unloading of excavation spoils on site in a storage pile for removal by truck;
- continuous operation of ventilation fans, air compressors, dewatering pumps, and diesel electric generators; and
- lowering of materials through the elevator shaft by crane to the station.

### **East Portal Construction Site**

At the East Portal site, demolition of existing structures, excavation, embankment wall construction, and cut and cover construction will be performed during daytime hours. After the arrival of the TBM at the west tunnel portal, the following construction operations will be performed 24-hours a day:

- access and supply to tunnel excavation (cross passages only) and concrete tunnel construction;
- disassembly and removal of the TBM; and
- access for civil and systems finish work within the tunnels.

The major construction activities that are expected to occur at the surface of each of the construction sites during nighttime hours are summarized and presented in Table 4-1. The table also includes the construction equipment that would be used during these different activities. There is no certainty that the Contractor will use this equipment, however, these do represent the noisiest equipment that could be used to perform these activities. Based on these scenarios, the expected noise levels at the construction sites are discussed at each of the noise measurement locations.

Construction activities that will occur underground, in tunnels, or in excavated cut-and-cover sections that are decked over are not included in this analysis since they are not expected to be noticeable at street level.

**Table 3-1**  
**Beacon Hill Above-Ground Nighttime Construction Activities**

<b>Construction Site</b>	<b>Construction Activity</b>	<b>Approximate Duration (Months)</b>	<b>Equipment</b>
<b>West Portal</b>	Mucking of excavated tunnel spoils. Supply of precast tunnel lining segments.	24	Small excavator Front end loader Loco's with muck cars 50 ton crane Dump trucks
	Excavation, excavation support, column underpinning, mechanically stabilized earth and embankments.	36	Excavator Loader Dump trucks Roller Compactor Grader Dozer Crane Welder Compressors Drill Rig Tieback equipment Concrete trucks
	Concrete construction.	36	Crane Loader Excavator Dump trucks Concrete pumps Concrete Trucks Compressors
	TBM assembly.	4	50 ton crane TBM crane 200 ton Compressors Welder
	Demolition.	4	Excavator Loader Dozer Dump trucks Compressors Jack hammers
	Trackwork installation.	2	Rail welding plant Loader Rail cars Speed swing Hi-Rail trucks Concrete pumps Concrete trucks Compressors

**Table 3-1 (Cont'd)**  
**Beacon Hill Above-Ground Nighttime Construction Activities**

<b>Construction Site</b>	<b>Construction Activity</b>	<b>Approximate Duration (Months)</b>	<b>Equipment</b>
	Systems installation.	12	Hi-rail trucks Hi-rail work platforms
	Tunnel ventilation	36	Fan
	Miscellaneous	48	Compressors Backhoe Dewatering pumps Concrete pumps Diesel electric generator Material delivery trucks
<b>Beacon Hill Station</b>	Shaft, tunnel, and basement excavation. Concrete and shotcrete construction.	24	Excavator Loader Shaft crane 35 ton crane Shotcrete equipment Generator compressors Manlift/Elevator Dump Trucks
	Mucking of excavated station spoils	24	Shaft crane 35 ton crane Front end loader
	Tunnel ventilation	36	Fan
	Miscellaneous	48	Compressors Backhoe Dewatering pumps Diesel electric generator
<b>East Portal</b>	Trackwork installation.	2	Rail welding plant Loader Rail cars Speed swing Hi-Rail trucks Concrete pumps Concrete trucks Compressors
	Systems installation.	12	Hi-rail trucks Hi-rail work platforms
	Access and supply to tunnel excavation and concrete construction.	6	Small excavator Loco's with muck cars Shotcrete equipment Compressors Fans Dump Trucks
	TBM disassembly and removal	3	50 ton crane Welder plant TBM crane (200 ton) Flatbed trucks

## 4.0 CONSTRUCTION NOISE LIMITS

### Noise Level Descriptors

Humans respond to noise in different ways. The intensity, or how loud a sound is, how often it occurs, the amount of background noise, and the nature of activity being affected by a noise can influence how an individual responds. Noise levels can be stated in the "A-weighted decibel scale" (dBA), which measures how sensitive the human ear is to sounds of different frequencies. Decibels are a logarithmic scale.

The following information, presented in the *Highway Noise Fundamentals*, Federal Highway Administration (FHWA), September, 1980, is helpful to interpret relative changes in noise levels.

- Except in carefully controlled laboratory experiments, an increase of 1 dBA cannot be perceived.
- Outside of the laboratory, a change of 3 dBA is considered a barely perceptible change in sound level.
- A change of 5 dBA is considered noticeable. This level of change is usually required before there is any significant community reaction to an increase in noise.
- A 10 dBA increase over the existing noise level is subjectively perceived as approximately a doubling in loudness.

Construction noise is measured using the following noise descriptors:

**Maximum Sound Level (*L<sub>max</sub>*):** It is often convenient to describe a particular construction noise "event" by its maximum sound level, abbreviated as *L<sub>max</sub>*. It is particularly appropriate for characterizing the noise level of a construction source. However, *L<sub>max</sub>*, does not give any information about how often the noise might occur or how long it may last.

**Equivalent Level (*Leq*):** *Leq* is a measure of sound energy over a period of time. It is referred to as the *equivalent sound level* because it is equivalent to the level of a steady sound, which, over a referenced duration and location, has the same A-weighted sound energy as the fluctuating sound. *Leq* for periods of one hour, the daytime or nighttime hours, and 24 hours are commonly used in environmental assessments. Because *Leq* is a measure of the total sound energy, any new construction noise source will cause the existing *Leq* of a community to increase.

## 4.1 City of Seattle Noise Ordinance

### Daytime Noise

The Administrative Code of the City of Seattle (Ordinance 102228), Chapter 25.08, Noise Control, regulates the noise levels of construction and equipment operations (Section 25.08.425). The ordinance requires any equipment used in commercial construction activities should not exceed the maximum permissible sound levels presented in Table 4-1. The levels should be measured from the real property of another person or at a distance of fifty feet (50') from the equipment, whichever is greater.

**Table 4-1  
Seattle Noise Ordinance  
Maximum Permissible Sound Levels**

District of Sound Source	District of Receiving Property Within the City of Seattle		
	Residential (dBA)	Commercial (dBA)	Industrial (dBA)
Residential	55	57	60
Commercial	57	60	65
Industrial	60	65	70

### Exceptions

Levels may be exceeded between the hours of 7 a.m. and 10 p.m. on weekdays and between the hours of 9 a.m. and 10 p.m. on weekends by no more than the following dBA's for the following types of equipment:

1. 25 dBA for equipment on construction sites, including but not limited to crawlers, tractors, dozers, rotary drills and augers, loaders, power shovels, cranes, derricks, graders, off-highway trucks, ditchers, trenchers, compactors, compressors, and pneumatic-powered equipment;
2. 20 dBA for portable powered equipment used in temporary locations in support of construction activities or used in the maintenance of public facilities, including but not limited to chainsaws, log chippers, lawn and garden maintenance equipment and powered hand tools; or
3. 15 dBA for powered equipment used in temporary or periodic maintenance or repair of the grounds and appurtenances of residential property, including but not limited to lawnmowers, powered hand-tools, snow-removal equipment and composters.

### Impact Equipment

Sound created by impact types of construction equipment, including but not limited to pavement breakers, pile drivers, jackhammers, sandblasting tools, or other types of equipment or devices which create impulse noise or impact noise or are used as impact equipment, as measured at the property line or 50 feet from the equipment (whichever is greater), may exceed the maximum permissible sound levels described above in any one-hour period between the hours of 8 a.m. and 5 p.m. on weekdays and 9 a.m. and 5 p.m. on weekends, but in no event is to exceed the following:

Leq = 90 dBA continuously;  
 Leq = 93 dBA for 30 minutes;  
 Leq = 96 dBA for 15 minutes;  
 Leq = 99 dBA for 7 minutes;

Sound levels in excess of Leq= 99 dBA are prohibited unless authorized by variance.

## 4.2 Nighttime Noise Limits

Recommended nighttime construction noise limits have been developed based on the measured existing nighttime noise levels (Table 2-1) and customized to each neighborhood.

The basis for establishing the nighttime construction noise limits is to mitigate noise impacts and to minimize any community reaction to increases in existing noise levels.

Federal agencies such as Environmental Protection Agency (EPA), Housing and Urban Development (HUD), Federal Highway Administration (FHWA), Federal Aviation Administration (FAA), and Federal Transit Administration (FTA) have developed noise standards based on well-documented criteria and research into human response to community noise. The primary goals in developing these noise criteria are to ensure that the impact limits for different types of projects (highway, transit, airport) be firmly founded in scientific studies, be realistically based on noise levels associated with new projects, and represent a reasonable balance between community impact and public benefit. The conclusion, supported by this research, is that a 5 dB increase at low ambient levels (40 - 50 dB) has less impact than at higher ambient levels (65 - 75 dB).

The nighttime construction noise level limits were determined by averaging the measured one-hour equivalent noise levels (Leq) during the five-hour period from 12 a.m. to 5 a.m. (instead of 10 p.m. to 7 a.m.) and using the sliding scale shown in Table 4-2 added to the average level. The hours of 10 p.m. to 12 a.m. and 5 a.m. to 7 a.m. were excluded from the nighttime average because these were considered transition periods when traffic noise and other activities were higher. The five hour period from 12 a.m. to 5 a.m. represents the quietest of the nighttime hours. These limits would apply to the operation of construction equipment during nighttime hours from 10 p.m. to 7 a.m.

**Table 4-2**  
**Sliding Scale Criteria for Nighttime Noise Level Increase**

<b>Measured Average Nighttime Noise Level</b>	<b>Allowable dBA Increase</b>
50 to 60	+5
61 to 65	+4
66 to 70	+3
71 to 75	+2
76 to 80	+1
81 and higher	0

The recommended nighttime noise level limits at the measurement locations for each of the construction sites are presented in Table 4-3. These noise limits will be confirmed prior to construction. The Contractor will be required to monitor the existing noise levels at each of the three construction sites for a minimum period of one month before construction begins. The location of the monitoring sites will be determined by DCLU. Based on the results of this measured data the noise level limits will be finalized by DCLU using the sliding scale criteria presented in Table 4-2.

**Table 4-3**  
**Maximum Nighttime Construction Noise Limits – Leq (dBA)**

Site	Location	Average Existing Nighttime Noise Levels (12 am – 5 am)	Construction Noise Level Limit
<b>West Portal Construction Site</b>			
WP 1	2917 12 <sup>th</sup> Avenue at Seaview Park	64 dBA	68 dBA
<b>Beacon Hill Station Construction Site</b>			
BH 1	El Centro - Jose Marti Child Development Center	56 dBA	61 dBA
BH 2	2608 17 <sup>th</sup> Avenue	58 dBA	64 dBA
BH 3	2702 17 <sup>th</sup> Avenue	60 dBA	
BH 4	2802 17 <sup>th</sup> Avenue	60 dBA	
BH 5	2820 17 <sup>th</sup> Avenue	61 dBA	
BH 6	Laura Apartments, 2610 16 <sup>th</sup> Avenue	60 dBA	65 dBA
BH 7	2817 16 <sup>th</sup> Avenue	56 dBA	61 dBA
BH 8	2801 16 <sup>th</sup> Avenue	57 dBA	62 dBA
BH 9	Lander Apartments, 2541 15 <sup>th</sup> Avenue	59 dBA	64 dBA
BH 10	2538 Beacon Avenue	60 dBA	65 dBA
<b>East Portal Construction Site</b>			
EP 1	3029 25 <sup>th</sup> Avenue	50 dBA	55 dBA
EP 2	2920 25 <sup>th</sup> Avenue	50 dBA	55 dBA
EP 3	Mt. Baker Apartments, 2569 29 <sup>th</sup> Avenue	68 dBA	71 dBA
EP 4	2905 McClellan Street	58 dBA	63 dBA
EP 5	2825 29 <sup>th</sup> Avenue	50 dBA	55 dBA

### 4.3 Nighttime Construction Noise Estimates

The construction noise levels were estimated at each of the construction sites. The noisiest construction activity that would occur at the surface of each construction site and the noisiest equipment were assumed for these estimates. The estimates of nighttime construction noise are based on the mandatory noise control measures that are imposed on the Contractor to use low noise emission equipment (see Section 5.2 and Table 5-1).

#### West Portal Construction Site

This West Portal construction site is at the bottom of the slope where Beacon Hill transitions to the industrial area west of Airport Way South. The nearest residences on 12<sup>th</sup> Avenue are approximately 150 to 180 feet higher than the portal structure. The expected noise levels at the nearest residence to this construction site on 12<sup>th</sup> Avenue have been estimated based on the construction activities expected to generate the highest noise levels, the excavation and construction of the excavation support and embankments for the portal structure. (Table 4-4). The estimate of mitigated noise levels includes the use of low-noise emission construction equipment. It does not include a 16-foot high noise barrier fence erected at the perimeter of the construction site since this would not benefit the residences on 12<sup>th</sup> Avenue, which are above the construction site. The continuously operating stationary equipment such as ventilation fans, compressors, pumps, and diesel electric generator are assumed to be enclosed and would not contribute to the noise from the mobile equipment sources.

The estimated nighttime construction noise levels, for the noisiest construction activities, would not exceed the proposed nighttime noise criteria of 68 dBA at the nearest residence to the West Portal construction site.

**Table 4-4**  
**Estimated Nighttime Construction Noise at West Portal Site**

Equipment	Equipment Noise Level at 50 feet – dBA*	Usage Factor	Total Noise Level Unmitigated at 50 feet Leq (dBA)
Excavator	81	25%	75
Loader	81	25%	75
Roller Compactor	75	25%	69
Grader	81	25%	75
Dozer	81	25%	75
Mobile Crane	81	25%	75
Welder	73	25%	67
Concrete Trucks (2)	81	10%	75
Dump Trucks (2)	81	10%	75
Total Noise Level for Nighttime Operations at 50 feet			84
Site	Receptor Location		Noise Level at Receiver Site (dBA)
WP 1	2917 12 <sup>th</sup> Avenue at Seaview Park	Unmitigated	64
		Mitigated	N/A

\* Based on the maximum permitted Noise Emissions for Construction Equipment Used at the surface of the construction site during nighttime hours of 10 p.m. to 7 a.m. (see Table 5-1).

N/A – Mitigation not identified since the estimated construction noise is predicted not to exceed the criterion of 68 dBA .

#### Beacon Hill Station Construction Site

The nighttime construction activities at this site will be centered around the two shafts and consist of mucking the spoils using a crane and bucket and the hoisting of materials to the underground station by crane. The spoils will be loaded onto trucks and transported from the site.

The expected noise levels at the ten measurement locations at this site have been estimated based on the construction activity that is expected to generate the highest noise levels, the excavation of the elevator and ventilation shafts, and excavation of the tunnel and headhouse basement (Table 4-5). The estimate of mitigated noise levels includes the use of low-noise emission construction equipment and the noise reduction provided by a 16-foot high noise barrier fence erected at the perimeter of the construction site. The continuously operating stationary equipment such as ventilation fans, compressors, pumps, and diesel electric generator are assumed to be enclosed and would not contribute to the noise from the mobile equipment sources.

The estimated mitigated nighttime construction noise levels, for the noisiest construction activities, would not exceed the proposed nighttime noise criteria listed in Table 4-3.



**Table 4-5**  
**Estimated Nighttime Construction Noise at Beacon Hill Station Site**

Equipment	Equipment Noise Level at 50 feet – dBA*	Usage Factor	Total Noise Level Unmitigated at 50 feet Leq (dBA)
Loader	81	50%	78
Excavator	81	50%	78
35 ton Crane	81	25%	75
Shaft crane	81	10%	71
Total Noise Level for Nighttime Operations at 50 feet			82
Site	Receptor Location		Noise Level at Receiver Site (dBA)
BH 1	El Centro - Jose Marti Child Development Center	Unmitigated	63
		Mitigated	58
BH 2	2608 17 <sup>th</sup> Avenue	Unmitigated	63
		Mitigated	58
BH 3	2702 17 <sup>th</sup> Avenue	Unmitigated	67
		Mitigated	62
BH 4	2802 17 <sup>th</sup> Avenue	Unmitigated	60
		Mitigated	55
BH 5	2820 17 <sup>th</sup> Avenue	Unmitigated	57
		Mitigated	52
BH 6	Laura Apartments, 2610 16 <sup>th</sup> Avenue	Unmitigated	62
		Mitigated	57
BH 7	2817 16 <sup>th</sup> Avenue	Unmitigated	59
		Mitigated	54
BH 8	2801 16 <sup>th</sup> Avenue	Unmitigated	63
		Mitigated	58
BH 9	Lander Apartments, 2541 15 <sup>th</sup> Avenue	Unmitigated	60
		Mitigated	55
BH 10	2538 Beacon Avenue	Unmitigated	60
		Mitigated	55

\* Based on the maximum permitted Noise Emissions for Construction Equipment Used at the surface of the construction site during nighttime hours of 10 p.m. to 7 a.m. (see Table 5-1).

### East Portal Construction Site

The nighttime construction activities at this site will consist of the disassembly and removal of the TBM, and access and supply to tunnel excavation (cross passages only), concrete tunnel construction, and access for civil and systems finish work within the tunnels. All other construction activities will be restricted to daytime hours.

The expected noise levels at the two measurement locations at this site have been estimated based on the construction activity that is expected to generate the highest noise levels, the disassembly and removal of the TBM using two cranes, front-end loader, and trucks to transport the TBM parts from the site. (Table 4-6). The estimate of mitigated noise levels includes the use of low-noise emission construction equipment and the noise reduction provided by a 16-foot high noise barrier fence erected at the north, east, and south sides of the construction site. The area to the west of the construction site is elevated at the top of a 35 foot slope of densely wooded vegetation. The natural topography of the area has the same effect as a berm or earthen noise barrier in reducing construction noise levels to the residences to the west of the construction site along 25<sup>th</sup> Avenue South. It is not expected that a noise barrier fence would be required at this location. However, if measurements of the construction activities are found to exceed the proposed nighttime noise criteria at these residences then the Contractor will be required to extend the noise barrier. The location and height of the noise barrier will have to be determined by the Contractor and approved by Sound Transit and DCLU.

The estimated mitigated nighttime construction noise levels, for the noisiest construction activities, would not exceed the proposed nighttime noise criteria listed in Table 4-3.

**Table 4-6**  
**Estimated Nighttime Construction Noise at East Portal Site**

Equipment	Equipment Noise Level at 50 feet – dBA*	Usage Factor	Total Noise Level Unmitigated at 50 feet Leq (dBA)
50 ton crane	81	25%	75
Welder plant	75	25%	69
TBM crane	81	25%	75
Flatbed Trucks (2)	81	10%	74
Total Noise Level for Nighttime Operations at 50 feet			80
Site	Receptor Location		Noise Level at Receiver Site (dBA)
EP 1	3029 25 <sup>th</sup> Avenue	Unmitigated	63
		Mitigated	55
EP 2	2920 25 <sup>th</sup> Avenue	Unmitigated	52
		Mitigated	44
EP 3	Mt. Baker Apartments, 2569 29 <sup>th</sup> Avenue	Unmitigated	47
		Mitigated	39
EP 4	2905 McClellan Street	Unmitigated	47
		Mitigated	39
EP 5	2825 29 <sup>th</sup> Avenue	Unmitigated	47
		Mitigated	39

\* Based on the maximum permitted Noise Emissions for Construction Equipment Used at the surface of the construction site during nighttime hours of 10 p.m. to 7 a.m. (see Table 5-1).

## **5.0 CONTRACTOR REQUIREMENTS**

### **5.1 Nighttime Construction Noise Level Limits**

The recommended nighttime noise level limits for the three construction site (Table 4-3) will be confirmed prior to construction. The Contractor will be required to monitor the existing noise levels at each of the construction sites for a minimum period of one month before construction begins. The location of the noise monitoring will be determined by DCLU. Based on the results of the measured data the noise level limits will be finalized by DCLU using the sliding scale criteria presented in Table 4-2 applied to the average of the ambient nighttime noise levels between the hours of 12 a.m. and 5 a.m.

### **5.2 Mandatory Noise Control Measures**

#### **Construction Site Noise Barrier Wall**

The Contractor shall construct a 16-foot high noise barrier wall around the full perimeter of the Beacon Hill Station site and around the perimeter of the East Portal construction site except for those lengths indicated on the drawings where the topography with steep terrain provides an earthen berm. A perimeter noise barrier wall would not benefit the noise sensitive receivers that would be affected by the West Portal construction activities since they are setback on the top of a bluff approximately 150 to 180 feet higher than the construction site. A standard non-acoustic perimeter wall could be erected at the West Portal site.

The noise barrier shall be made of two layers of 3/4-inch Medium Density Overlay (MDO) plywood sheeting or acceptable equal. The construction site side of the wall shall be lined with glass fiber or a mineral wool type noise-absorbing material at least two inches thick and protected using wire mesh or perforated sheets that are corrosion resistant and have at least 30 percent open area and provision for water drainage. The noise barrier wall assembly shall have a transmission loss of sound transmission class (STC) of 30 or greater, and a Noise Reduction Coefficient (NRC) rating of NRC-0.50 or greater. The noise barrier wall will be constructed of material that will last for the duration of construction of this Contract.

Gates and/or doors in the wall either hinged or rolling, shall be constructed of the same or equally effective material as the noise barrier wall. Edges of the gates and doors shall overlap the fence to eliminate gaps. During nighttime hours, gates and doors will be kept closed, except for brief periods of time to allow access to the construction site.

The use of noise barrier fences is a minimum noise control requirement that may not provide sufficient noise reduction to meet the daytime or nighttime construction noise. It is the Contractor's responsibility to meet these limits by other methods such as raising the height of the noise barrier fences and providing additional noise control measures.

#### **Backup Alarms**

Switch all vehicle back-up alarms to strobe warning lights and/or dedicated signal persons between the hours of 10 p.m. and 7 a.m.

#### **Low-Noise Emission Equipment**

During nighttime hours, the Contractor will be allowed to only use equipment at the surface of the construction site that, operating under full load, meets the noise limits specified in Table 5-1. The Contractor will be required to test this equipment to certify compliance with the emission levels. The following test procedures will be used for equipment noise certification:

- Operate engine-powered equipment at maximum governed rpm under full load conditions. Test under the supervision of the Acoustical Engineer.

- Conduct noise measurements at two locations, two feet from the right and left sides of the equipment casing, at a distance of 50 feet and a height of 5 feet above ground level, with the equipment operating at maximum load conditions for a minimum period of one minute. Measurements made at less than 50 feet, because of space limitations at the test site, should be adjusted to estimate the 50-foot sound level.
- Measure equipment noise as octave band sound pressure levels in the frequency range of 31.5 Hz to 8000 Hz and as A-scale sound levels.
- Submit a noise measurement test report to Sound Transit and the City of Seattle for each item of equipment used on the surface of the construction site during nighttime hours.
- Remove equipment from nighttime use if the noise levels obtained during the tests exceed those specified in Table 5-1, until such equipment is modified and retested, or substitute other equipment to meet the noise level requirements.

Noise compliance testing will remain valid for a period of six months only at which time the equipment is to be retested. Spot testing will be conducted by the Resident Engineer or Sound Transit's representative to determine that the equipment in use meets the noise emission requirements specified in Table 5-1.

If the Contractor's existing equipment on-site does not meet nighttime noise emission limits for surface construction activities specified in Table 5-1 or falls out of compliance, the equipment will promptly be removed from nighttime service by parking and turning off equipment when it is safe to do so, or taking remedial action to comply.

### **Trucks Operations**

All haul trucks that remove spoils from the construction sites should have their beds and walls, lined with sound-deadening material to minimize the impact sounds of the excavated materials falling onto the hard metal surfaces of the truck bed.

Trucks used during nighttime hours at the Beacon Hill construction sites will be subject to the variance noise level limits in Table 4.3, Nighttime Construction Noise Limits.

### **Additional Noise Control Measures**

- Ensure that all equipment meets the noise limits and is properly maintained and operated.
- Line or cover storage bins, conveyors, and chutes with sound-deadening material.
- Equip noise-producing equipment with acoustically attenuating shields or shrouds as is feasible and recommended by the manufacturers thereof, to meet relevant noise ordinance limitations.
- Fit nighttime surface equipment with high-grade engine exhaust silencers and engine-casing sound insulation to meet lower emission limits as specified in Table 7-1.
- Prohibit jack hammering and impact pile driving during nighttime hours. *Impact or impulse tools used from 5 p.m. to 10 p.m. would be subject to a noise level limit of 5 dBA above the existing noise level.*
- Enclose electrical generators, ventilation fans, pumps, concrete batch plants and air compressors.
- Use electric welders powered from utility main lines instead of electric generators/welders.
- Use two-way radios for communication and limit the use of public address systems during nighttime hours, except for emergency notifications.

- Grade surface irregularities on construction sites to prevent impact noise and ground vibrations by passing vehicles.

**Table 5-1**  
**Maximum Permitted Noise Emissions for Construction Equipment Used During Nighttime Hours\***

<b>Equipment Category</b>	<b>Maximum Noise Level at 50 feet - Lmax (dBA)</b>
Auger Drill Rig	81
Backhoe	75
Bar Bender	75
Boring Jack Power Unit	80
Chain Saw	81
Compactor (ground)	75
Compressor**	65
Compressor (other)	75
Concrete Mixer	71
Concrete Pump	77
Concrete Saw	81
Crane (mobile or stationary)	81
Dozer	81
Dump Truck	81
Excavator	81
Flat Bed Truck	81
Front End Loader	75
Generator***	69
Gradall	81
Grader	81
Horizontal Boring Hydraulic Jack	80
Jackhammer	81
Paver	81
Pickup truck	55
Pneumatic Tools	81
Pumps	77
Rock Drill	81
Scraper	81
Soil Mix Drill Rig	80
Tractor	79
Vacuum Excavator (Vac-Truck)	81
Vacuum Street Sweeper	80
Welder	73
All other equipment > 5HP	81
<p>* Noise emissions apply to equipment used at the surface of the construction site during nighttime hours of 10 p.m. to 7 a.m.</p> <p>** Portable Air Compressor that is rated at 75 cfm or greater and that operates at greater than 50 psi.</p> <p>*** Use Quiet Generators from MQ Power, or equivalent, to meet the noise limits.</p>	

### **5.3 Specifications**

The specifications require that the contractor perform construction operations in a manner to minimize noise at sensitive receptors. The contractor shall comply with the requirements of the City of Seattle's Noise Ordinance and the nighttime noise level limits of the Variance.

The contractor is required to prepare a Noise Control Plan and Noise Monitoring Plan, which shall be submitted, to Sound Transit and the City of Seattle (Noise Abatement Section of the DCLU).

The Noise Monitoring Plan will be based on the noise measurement locations identified in this Plan where the contractor will take noise measurements a minimum of three times a week. At the discretion of Sound Transit and the Noise Abatement Section of the DCLU, these measurement locations will be subject to change either by replacing these sites with new measurement locations or by adding additional measurement locations. Any new noise measurement sites will require 24-hour measurement of the background noise levels without any construction activities. The draft version of the specification section, Construction Noise and Vibration Control is included in Appendix B.

### **5.4 Acoustical Engineer**

Within 15 days of Notice To Proceed (NTP) which is expected to be spring 2004, the Contractor is required to submit to Sound Transit and the Noise Abatement Section of the DCLU, the name, address, and qualifications of the Acoustical Engineer responsible for preparing and overseeing the implementation of the Noise Control and Monitoring Plan.

The minimum requirements for the Acoustical Engineer are a Bachelor of Science Degree or higher degree, from a qualified program in engineering, physics, or architecture offered by an accredited university or college, and five years experience in noise control engineering and construction noise analysis, or current enrollment as a full Member or Board-certified Member in the Institute of Noise Control Engineering. In addition to the basic requirements shown above, the Acoustical Engineer must demonstrate substantial and responsible experience in preparing and implementing construction noise control and monitoring plans on construction projects conducted in an urban setting, calculating construction noise levels, and designing and overseeing the implementation of construction noise abatement measures.

### **5.5 Noise Control Plan Guidelines**

Within 45 days of NTP, the Contractor is required to submit a Noise Control Plan to Sound Transit and the City of Seattle for review and approval. The Noise Control Plan will include the following information for all nighttime construction activities that may occur at the surface of any construction site:

- A scaled site drawing of the construction site indicating the noise sensitive locations near the construction site, locations of construction equipment used during nighttime hours, and locations and types of noise abatement measures that may be required to meet the Variance noise limits.

- An inventory of equipment to be used during nighttime hours.

- Noise calculations of nighttime one-hour  $L_{eq}$  noise levels expected at the noise receivers presented in Section 3 of this report.

- Description of required noise control measures to meet the Variance nighttime noise limits.

- Identification of truck queuing areas and hauling routes.

The Noise Control Plan will be updated at three-month intervals and resubmitted to Sound Transit within 10 days of the start of each quarterly period. The Plan will also be updated and re-submitted when there are any major changes in work schedule, construction methods, or equipment operations not included in the

most recent Plan.

## **5.6 Noise Monitoring Plan Guidelines**

Within 45 days of NTP, the contractor will submit its Noise Monitoring Plan to Sound Transit and the City of Seattle for review and approval. The plan should specify the nighttime construction activities, monitoring locations, equipment, procedures, schedule of measurements and reporting methods to be used. The noise monitoring data is to be submitted to Sound Transit on a weekly basis.

Noise measurements will be conducted regularly for 20 to 60 minutes at each of the noise receiver locations presented in Section 3 of this report. The measurement methodology and noise descriptors that should be monitored are discussed in detail in Section 1564 of the Contract Specifications, "Construction Noise and Vibration Control" (Appendix B).

In the event that the measured noise levels exceed the nighttime noise limits, the Contractor will immediately stop the activity and notify Sound Transit. The Contractor will also immediately implement additional Noise Abatement Measures as specified in the Noise Control Plan or terminate the nighttime construction activity responsible for the noise limits exceedance until the daytime hours when higher noise levels are permitted.

## **5.7 Discretionary Noise Control Measures**

It is up to the discretion of the Contractor to schedule construction activities. As part of the Noise Control Plan, the Contractor will identify noise control measures based on the estimated noise levels generated by these activities. The mandatory noise control measures such as construction site noise barrier fences are minimum noise control requirements that may not provide sufficient noise reduction to meet the nighttime construction noise limits. It is the Contractor's responsibility to meet these noise limits by other methods such as raising the height of the noise barrier fences, providing additional noise control measures such as moveable temporary noise barriers or noise control curtains, and/or prohibiting the use of noisier activities during nighttime hours.



## **6.0 CITIZEN INVOLVEMENT AND PUBLIC COMPLAINT RESOLUTION**

### **6.1 Public Information**

Sound Transit's public involvement program will continue through construction. Periodic public meetings, construction update flyers, and updates to the web page will be used to inform the public about the progress of construction and upcoming activities. Staff will also visit adjacent businesses and homes to discuss construction activity.

### **6.2 Public Complaint Coordination**

Public complaints regarding construction noise can be considerable. An important element of this Noise Control and Monitoring Plan is an effective mechanism for tracking, evaluating and resolving public complaints by taking appropriate corrective measures.

It is the prime responsibility of the Contractor to monitor the construction activity and the equipment used on the project to ensure that there will be no need for the public to complain about noise. However, any public complaints must be addressed promptly and efficiently. Sound Transit will be responsible for implementing the conditions of the Noise Variance and working with the Contractor on remedying noise complaints (see 6.5 below). The City of Seattle will also be involved in implementation and oversight of the noise variance in a role to be defined before the variance is approved.

### **6.3 Evaluation**

The contractor is expected to measure the noise level for a minimum of 20 minutes to one-hour at the logged complaint location(s). The measured noise levels should be recorded on the "Noise Measurement Report Form". In addition, the contractor should ensure that noise measurements are taken whenever the construction activity that caused the noise complaint occurs again at the same complaint location. If the measured levels exceed the allowable nighttime noise limits, the noise levels should be reduced by appropriate abatement measures to comply with the Noise Variance.

### **6.4 Documentation**

The Contractor will prepare a bimonthly report that presents the measured nighttime construction noise levels, complaint log and a discussion of the mitigation measures that were implemented during the reporting period. The report will be submitted to Sound Transit and DCLU for review, and Sound Transit will work with the Contractor to resolve any noise issues identified in the report.

### **6.5 Construction Hotline Procedures**

Sound Transit will maintain a 24-hour construction hotline for citizens to call about noise levels and other issues associated with light rail construction activity. The number will be posted in conspicuous locations at the job sites and be distributed to local residents and businesses. The hotline will be staffed during normal working hours. After hours, callers will be able to leave a voice mail message that will automatically page a staff person on call. The staff person on call will then respond to the caller within a maximum of 2 hours, although the goal will be to respond much more quickly.

All calls will be logged with the name of the caller, time of call, location and nature of the complaint and source and location of the noise. Sound Transit will assist in analyzing community complaints; will provide technical guidance on abatement measures; and will provide the required interface with the contractor, City of Seattle and the Public.

The following procedures will be followed when a call is received:

Hotline call is answered by Sound Transit staff person during normal business hours. On weekends, holidays or after hours an on-call staff person receives a pager call. All pager calls will be returned within 2 hours.

Staff gathers needed information from the caller (initiating an entry in the construction hotline database) including the following:

- Description of noise/disruption: what it sounded like, duration of the noise, and approximate location of the noise.
- Caller's name
- Phone/contact number
- Address
- Time of occurrence

Call is logged into the construction hotline database.

Caller is asked if he/she would like a response later to hear resolution.

Staff evaluates the call and determines the timing and nature of response required. Timely resolution of complaints will be a Sound Transit priority.

If immediate action is necessary, Sound Transit may take any or all of the following actions:

Contact construction site

Go to construction site to investigate

Take noise measurements

If item generating complaint is found to violate permit conditions or established construction procedures, Sound Transit will require the contractor to cease the violation immediately.

If immediate action is not necessary, Sound Transit will begin to investigate the source of the complaint and work to resolve the issues on the next business day.

Sound Transit will make reasonable efforts to resolve each complaint.

Sound Transit will record all complaints and follow-up in hotline database.

A summary report of all calls to the hotline and their resolution status will be provided to the construction manager weekly.

Copies of call detail will be available for public review.

Sound Transit will require the Contractor to cease the activity or shut off the equipment that is identified as exceeding the nighttime noise limits.

General contractors will be responsible for informing all sub-contractors of noise restrictions, communication policies and complaint resolution process and ensuring their compliance.

**APPENDIX A**

**EXISTING 24-HOUR NOISE MEASUREMENTS**

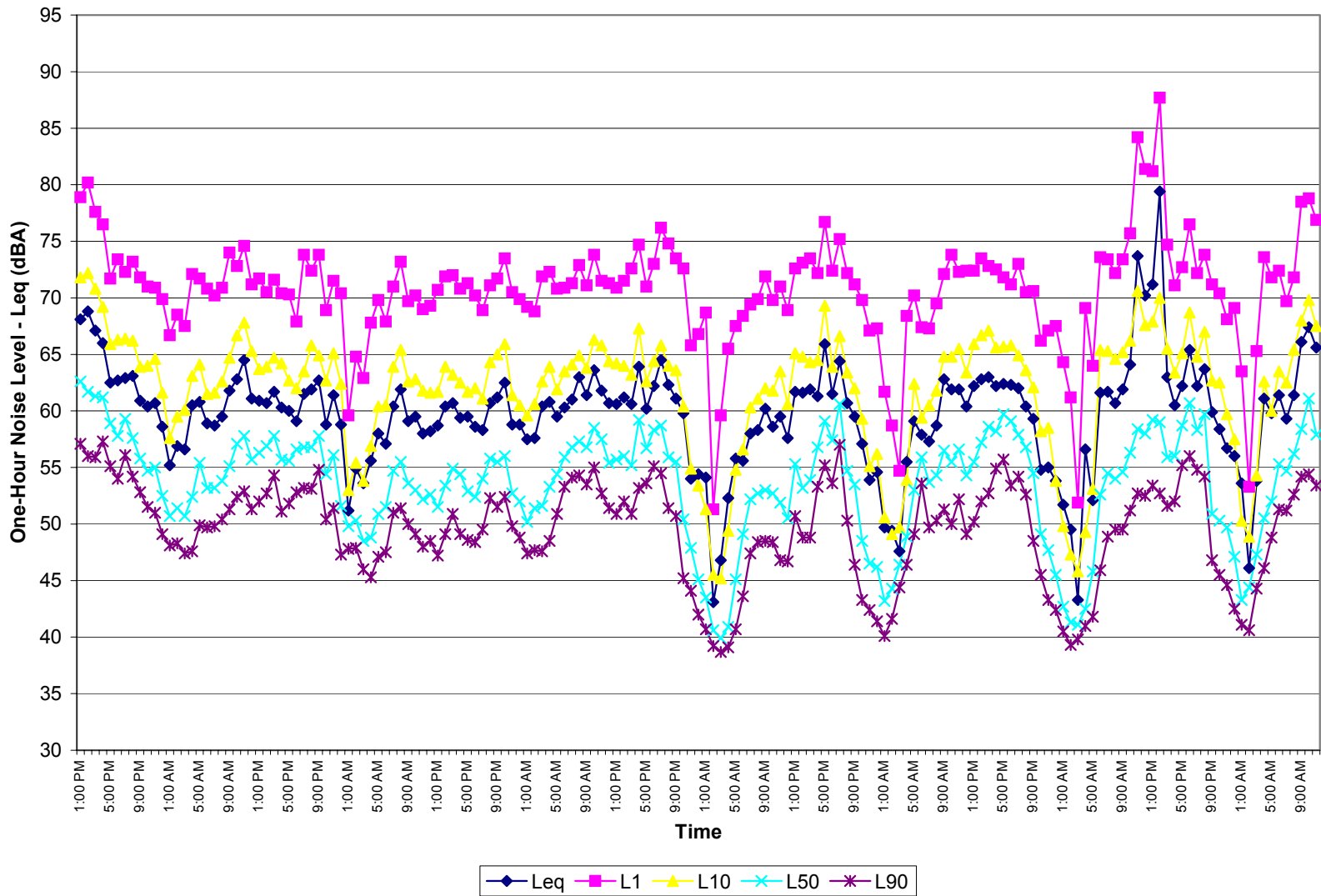


Figure A-1 – El Centro (Site BH 1)

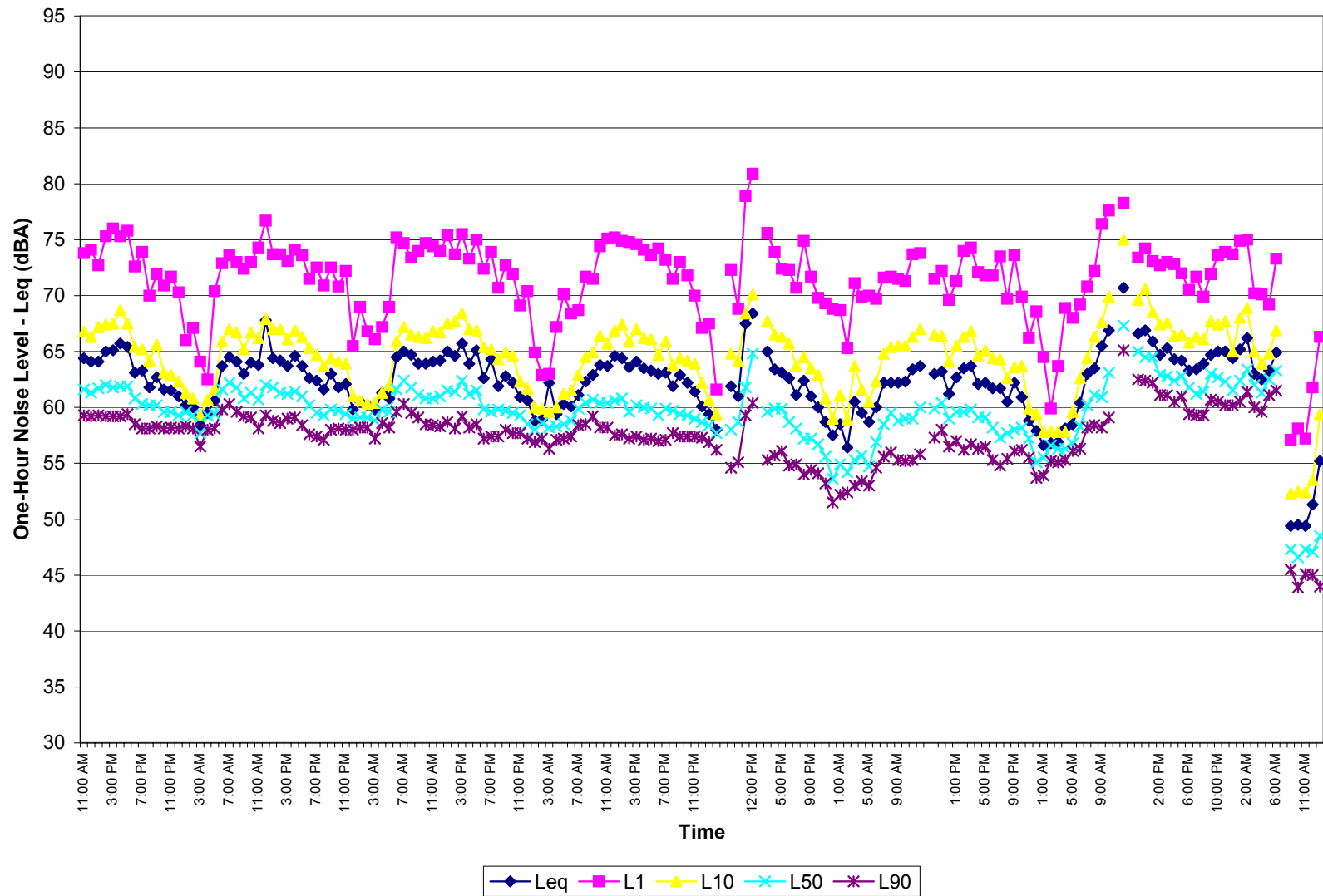
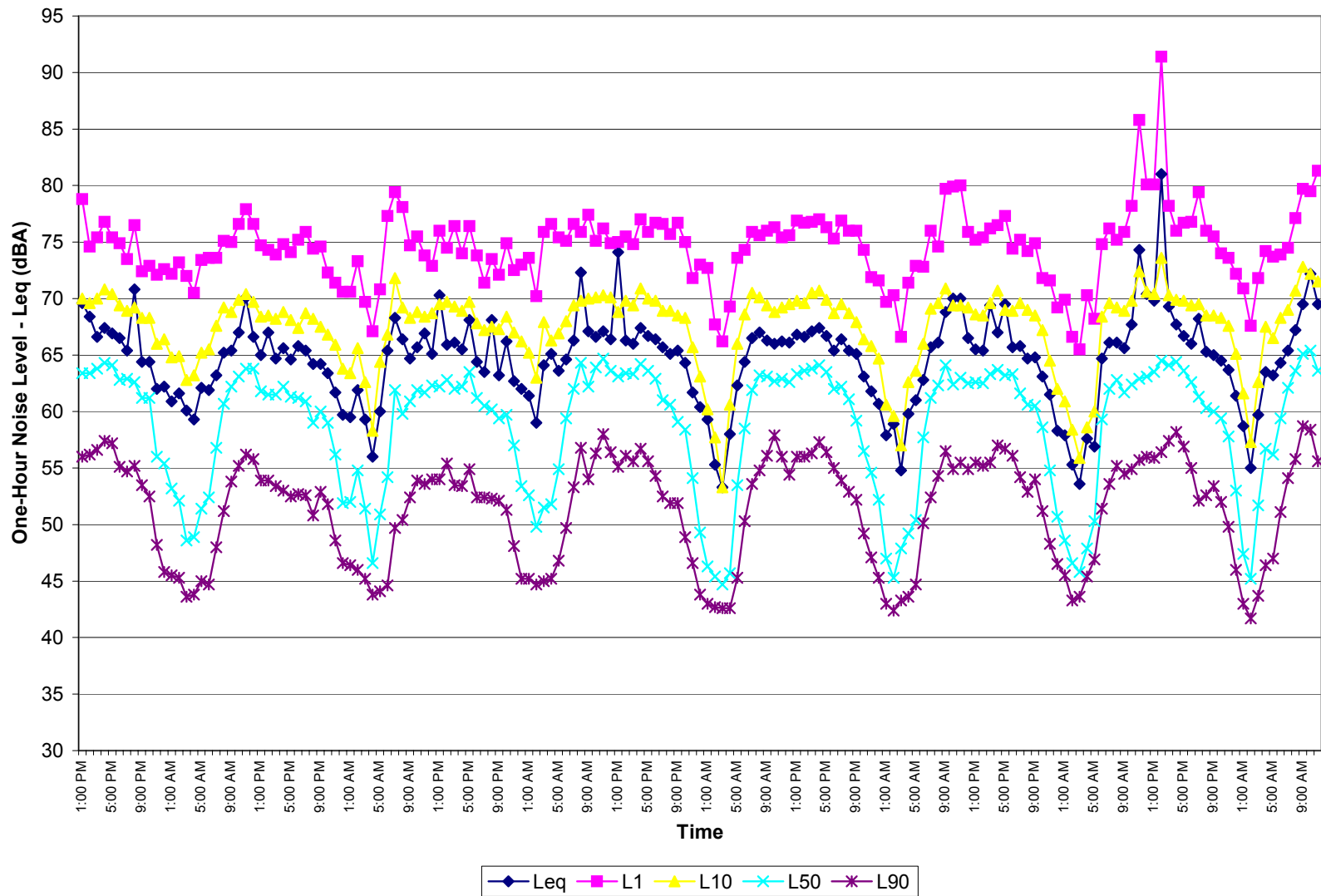
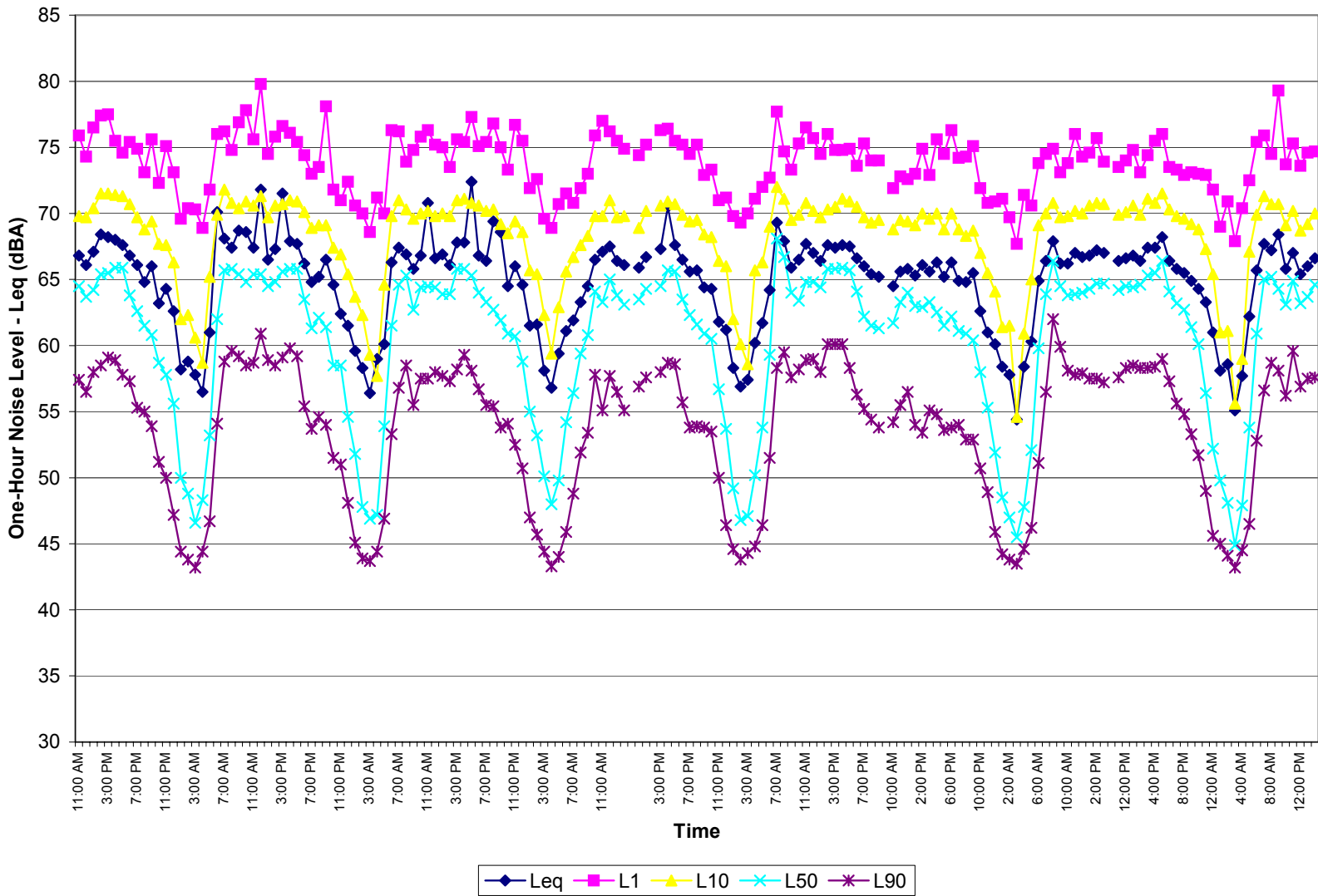


Figure A-2 – 2802 17<sup>th</sup> Avenue (Site BH 4)





## Beacon Hill Tunnel & Station Contract

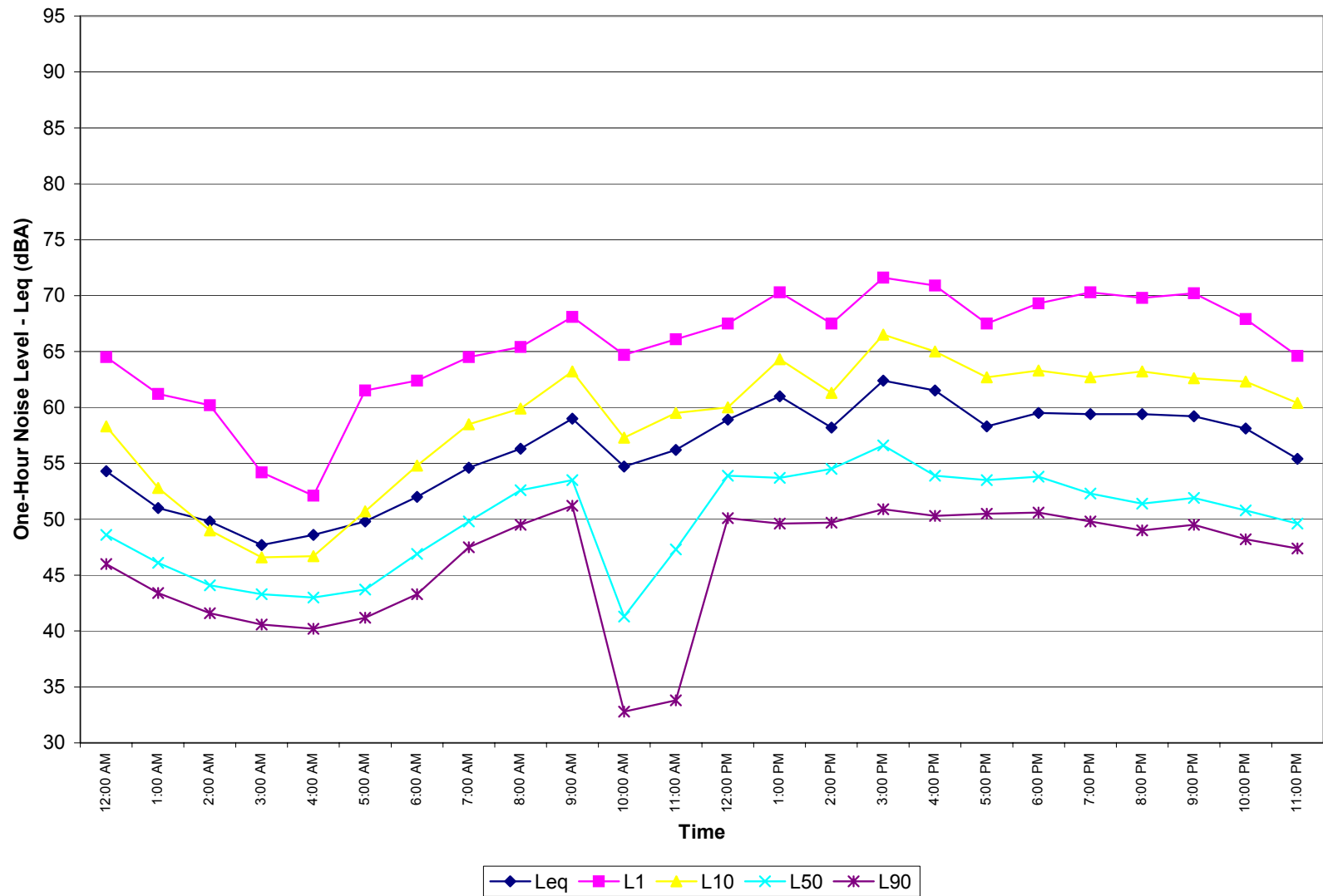


Figure A-5 – 3029 25<sup>th</sup> Avenue (Site EP 1)



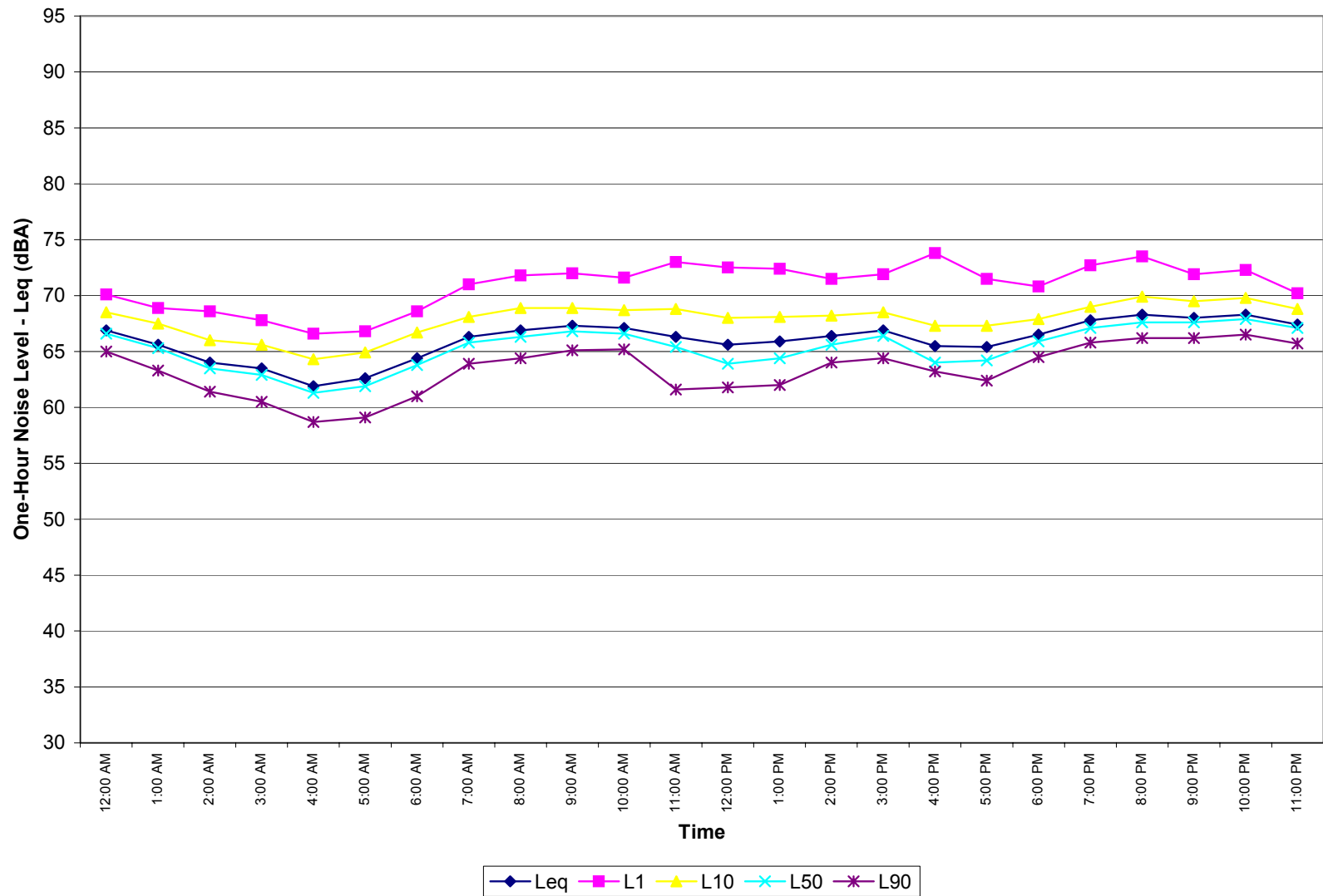


Figure A-6 – 2569 29<sup>th</sup> Avenue S (Site EP 3)

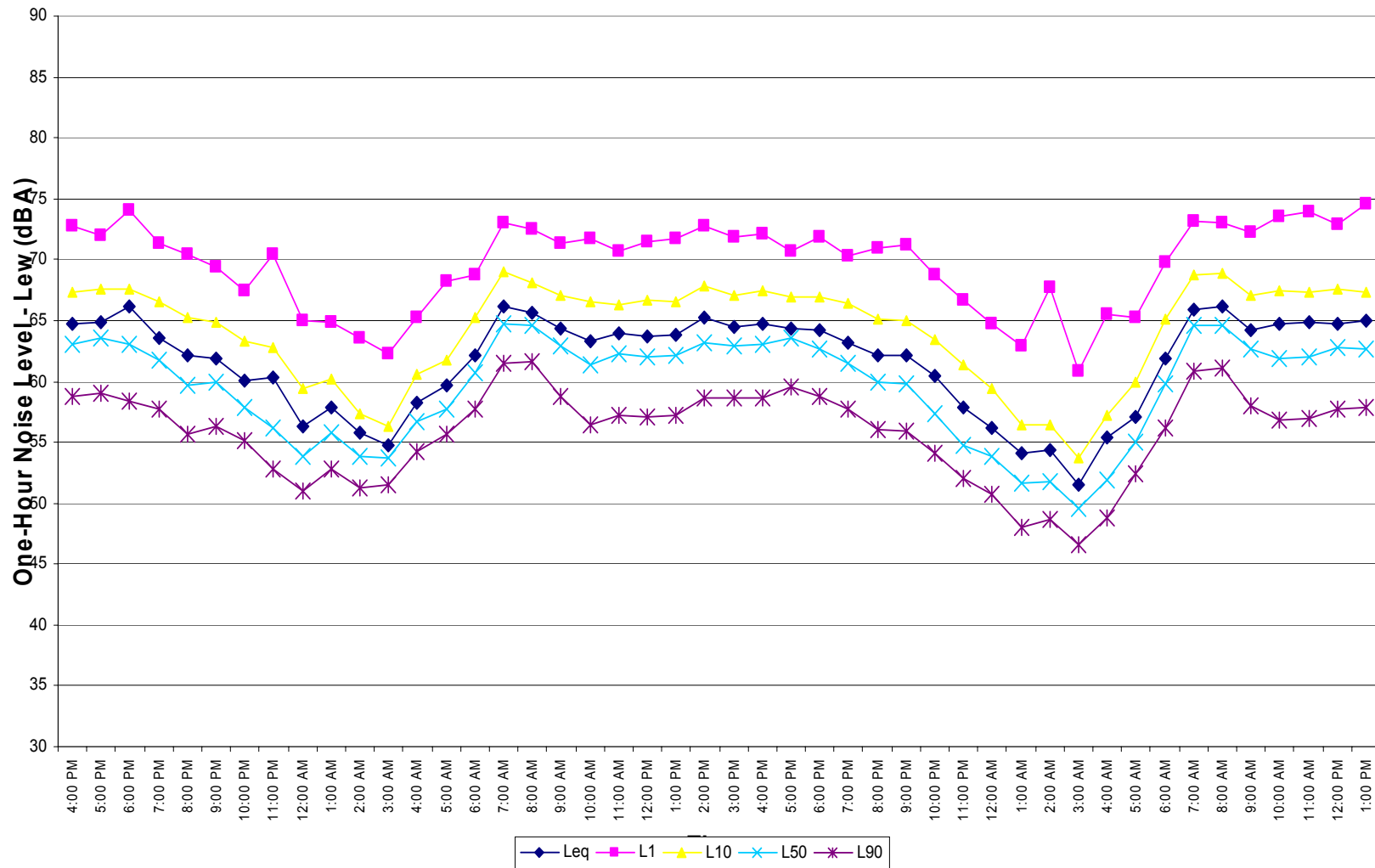


Figure A-7 – 2905 McClellan St. (Site EP 4)

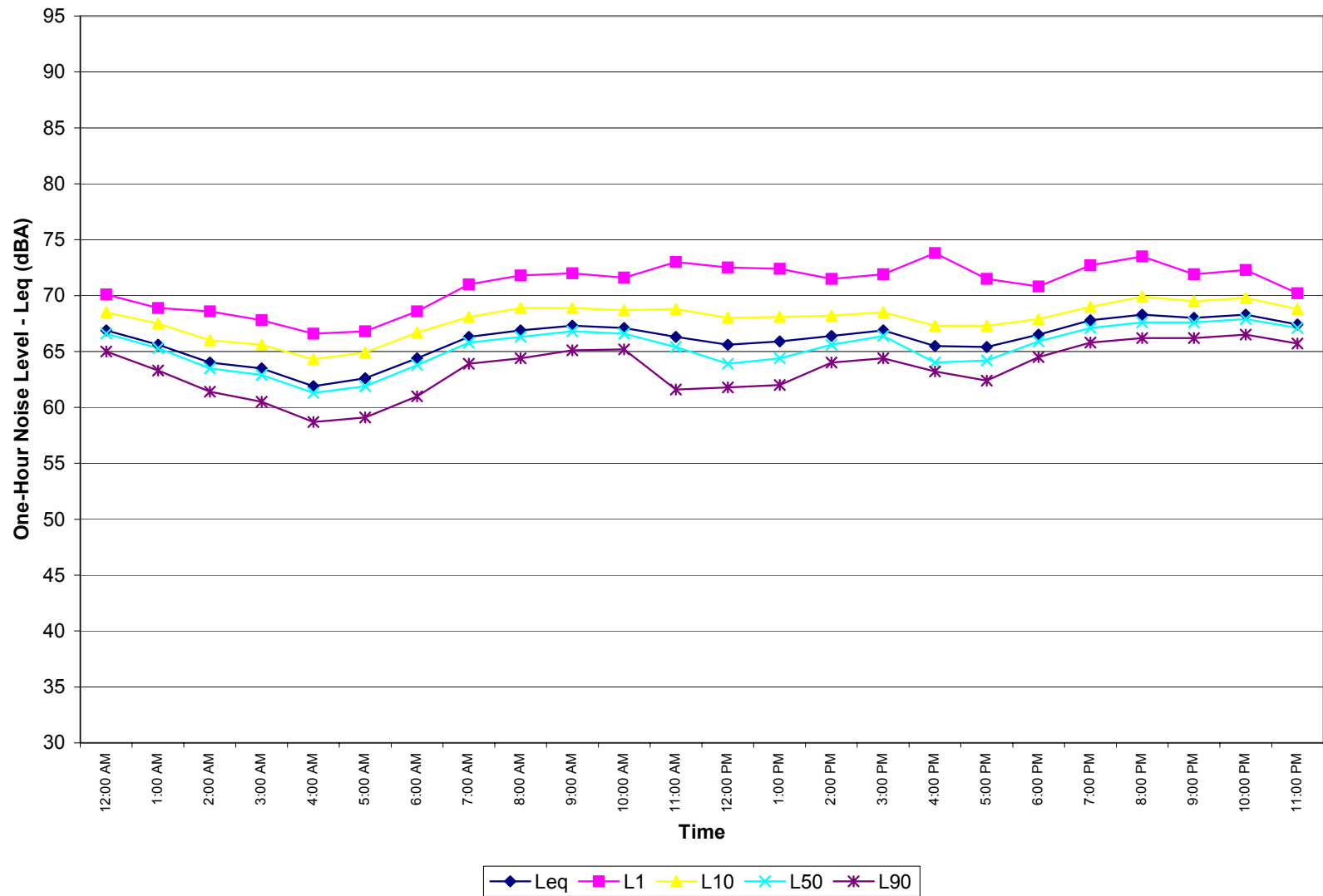


Figure A-8 – 2917 12<sup>th</sup> Avenue (Site WP 1)

**APPENDIX B**

**CONSTRUCTION NOISE AND VIBRATION CONTROL  
SPECIFICATION**

## SECTION 01565

### **CONSTRUCTION NOISE & VIBRATION CONTROL**

#### **PART 1 - GENERAL**

##### **1.1 DESCRIPTION**

- A. The Work specified in this Section consists of eliminating or minimizing noise and vibration generated by construction activities and of complying with applicable noise regulations, specification requirements, and noise and vibration limits specified within this Section.
- B. Sound Transit has prepared an Environmental Impact Statement for the Light Link Rail Project, with supporting technical reports on noise and vibration, which describes impacts the Project, will have on environment and indicate measures the Authority has agreed to implement.
- C. Sound Transit has submitted a Variance application from the Seattle Department of Design Construction and Land Use (DCLU) for nighttime construction for this Contract. Upon receipt of the nighttime noise Variance, the Contractor may schedule Work at night, but comply with provisions of Variance to Administrative Code of the City of Seattle (Ordinance 102228), Chapter 25.08, Noise Control, and the provisions herein. ((The Variance will be withdrawn if the construction noise levels reach a point where substantial community complaints are registered with the Seattle DCLU or the construction noise exceeds the maximum permissible noise level limits, as specified in Paragraph 3.1, from 10:00 p.m. to 7:00 A.M. Monday through Friday, from 10:00 p.m. Friday to 9:00 A.M. Saturday and Sunday.
- D. Use equipment with effective noise-suppression devices and employ other noise control measures such as enclosures and barriers necessary to protect the public. Schedule and conduct operations in a manner that will minimize, to the greatest extent feasible, the disturbance to the public in areas adjacent to the construction activities and to occupants of buildings in the vicinity of the construction activities.
- E. Submit a Noise Control Plan and a Noise Monitoring Plan, as specified in this Section. Both plans shall be prepared by an Acoustical Engineer meeting the qualifications specified in Paragraph 3.2 A.2. Do not operate noise generating construction equipment at the construction site prior to acceptance of the Noise Monitoring Plan. Update Noise Control Plan every three months.
- F. Compliance with the requirements of this Section may require the use of equipment with special exhaust silencers or enclosures, and construction of temporary enclosures or noise barriers around activities. Use haul routes and staging areas, as approved by the Authority and the City of Seattle to minimize noise at residential and other sensitive receptor sites. Do not operate trucks used for removal of excavated material and delivery of construction materials on local residential streets or on streets that pass by schools during school hours, unless specifically accepted by the Resident Engineer.
- G. Definitions
  - 1. Construction Site: For purpose of noise and vibration control requirements, the Contract limits of construction. This includes Right-of-Way lines, property lines, construction Easement Boundary or property lines and Contractor staging areas outside the defined boundary lines, used expressly for construction.
  - 2. Noise Level Measurements: Unless otherwise indicated, the use of A-weighted and "slow"

response of instrument complying with Type 2 requirements of latest revision of American National Standard Institute (ANSI) S1.4, Specification for Sound Level Meters.

3. A-Weighted Noise Levels: Decibels (referenced to 20 micro-Pascal) as measured with A-weighting network of standard sound level meter, abbreviated dBA.
  4. Vibration Measurements: The use of a vibration transducer, amplifier, peak detector, and frequency band filters complying with ANSI S2.4.
  5. Vibration: Velocity in micro-inches per second. Vibration levels are expressed as velocity levels in Decibels referenced to one microinch per second, abbreviated VdB.
  6. Daytime: The period from 7:00 AM to 10:00 p.m. Monday through Friday local time, and Saturdays, and Sundays 9:00 a.m. to 10:00 p.m.
  7. Nighttime: Periods other than daytime.
  8. Noise Sensitive Locations: Residential areas, institutions, hospitals, parks, and other locations so named herein.
  9.  $L_{max}$ : The maximum measured sound level.
  10. One-Hour  $L_{eq}$  A-weighted Equivalent Sound Level: The continuous sound level that represents the same sound energy as the varying sound levels over one hour.
  11. Sound Transmission Class (STC): A single number rating calculated in accordance with ASTM E413, using values of sound transmission loss. It provides an estimate of the performance of a partition in certain common sound insulation problems.
- H. The Resident Engineer will monitor Contractor's performance of tasks specified, and will inspect necessary records, reports and procedures.
- I. Designate staff member as Noise and Vibration Control Representative to be trained by and work with the Acoustical Engineer specified in Paragraph 3.2 of this Section.
- 1.2 QUALITY CONTROL - Comply with the requirements of the following:
- A. Section 01450, Contractor Quality Control.
  - B. Washington Code of Regulations (WCR).
  - C. Washington Health and Safety Code (CHSC).
  - D. City of Seattle Administrative Code (Ordinance 102228), Chapter 25.08, Noise Control (Noise Ordinance)
  - E. Code of Federal Regulations (CFR)
  - F. Environmental Protection Agency (EPA), State and local authorities.
  - G. Federal Occupational Safety and Health Act (OSHA) and Washington Occupational Safety and Health Act (WOSHA).
  - H. Reference Standards
    1. American National Standards Institute (ANSI)

ANSI S1.4      Specification for Sound Level Meters

ANSI S2.4      Auxiliary Analog Equipment for Shock and Vibration Measurements

2. American Society for Testing and Materials (ASTM)

ASTM E90      Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

ASTM C423      Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

ASTM E413      Classification for Rating Sound Insulation

3. International Electrotechnical Commission (IEC) - IEC 179 Precision Sound Level Meters

4. Occupational Safety and Health Act (OSHA) regulations.

5. Society of Automotive Engineers (SAE)

SAE J88          Sound Measurement Off-Road Work Machines - Exterior

SAE J366          Exterior Sound Level for Heavy Trucks and Buses

1.3      RESPONSIBILITIES OF CONTRACTOR

- A. Perform Work within the permissible noise levels, work schedule limitations, and procedures provided for in this Section and applicable Federal, state, county and municipal codes, regulations, and standards.
- B. Other than those provided herein, be responsible for obtaining, at Contractor's own expense, permits, variances, equipment certifications, and other documents required by this Section and by applicable Federal, state, county and municipal codes, regulations and standards.
- C. With regard to noise monitoring, include the following:
  - 1. Furnish instrumentation for noise monitoring that complies with the standards specified in Paragraphs 1.1 G.3. and 1.1 G.4. and that is capable of measuring the sound levels defined in Paragraphs 1.1 G.9., and 1.1 G.10.
  - 2. Collect and report noise monitoring data, report whether the noise monitoring data indicates compliance under Paragraph 3.1, and submit a Noise Measurement Report to the Resident Engineer on a weekly basis.
  - 3. Provide access to the Resident Engineer to review measured data and coordinate the Contractor's schedule for noise monitoring.
  - 4. Implement noise abatement measures as required by this Section, based on the Contractor's noise monitoring data, public complaints, and nuisance conditions reported by the Residence Engineer.

1.4      SUBMITTALS - Refer to Section 01300, Submittals, for submittal procedures.

- A. Qualifications and work experience of the acoustical engineer as specified in Paragraph 3.2 of this Section. This submittal is required before the submittal of the Noise Control and Noise

Monitoring Plans.

- B. Contractor's Noise Control Plan as specified in Paragraph 3.2 of this Section.
- C. Contractor's Noise Monitoring Plan and the weekly Noise Measurement Reports as specified in Paragraph 3.3 of this Section.
- D. Noise measurement equipment makes and models, and calibration conformance certificates as specified in Paragraph 3.4 of this Section.
- E. Equipment noise certification reports as specified in Paragraph 3.4 of this Section.
- F. Shop and Working Drawings, computations, material data and other criteria, for noise abatement measures, identified in the Noise Control Plan and for moveable noise barriers, noise barrier fences and noise control curtains as specified in Paragraphs 2.2, 2.3 and 2.4 herein. Have drawings and computations stamped by a Registered Professional Engineer in the State of Washington.
- G. Materials data required by Part 2 of this Section.

**PART 2 - PRODUCTS**

- 2.1 NOISE CONTROL MATERIALS may be new or used. Used materials shall be sound and free of damage and defects and shall be of a quality and condition to perform there designed function.

2.2 NOISE BARRIER FENCES

- A. Use material that will last for the duration of construction of this Contract. Construct using two layers of 3/4 inch Medium Density Overlay (MDO) plywood sheeting or acceptable equal.
- B. Line the construction site side with glass fiber or mineral wool type noise-absorbing material at least two inches thick. Protect this material using wire mesh or perforated sheets that are corrosion resistant and that have at least 30 percent open area and provision for water drainage.
- C. Provide a wall assembly with a STC-25 or greater, based on certified sound transmission loss data taken according to ASTM E90 and a Noise Reduction Coefficient (NRC) rating of NRC-0.75 or greater, based on certified sound absorption coefficient data taken according to ASTM C423.
- D. Construct gates and doors of the same material as the noise barrier fence or acceptable equal.

2.3 MOVEABLE NOISE BARRIERS

- A. Construct moveable barriers of 3/4-inch Medium Density Overlay (MDO) plywood sheeting, or other acceptable material with a STC25 rating or greater.
- B. Line barriers on construction site side with glass fiber or mineral wool type sound absorbing material at least two inches thick. Protect this material by wire mesh or perforated sheets that are corrosion resistant and that have at least 30 percent open area, with provision for water drainage.
- C. Provide materials and details of construction sufficiently weather-resistant to last through the duration of construction of this Contract.



D. Construction Details

1. Attach barrier panels to support frames constructed in sections to provide a moveable barrier utilizing the standard temporary precast concrete median barrier or other supports.
2. When barrier units are joined together, overlap the mating surfaces of the barrier sides or make flush with each other. Close gaps between barrier units, and between the bottom edge of the barrier panels and the ground, with material that will completely close the gaps and be dense enough to attenuate noise.
3. The height of the barriers - Not greater than 15 feet.

2.4 NOISE CONTROL CURTAINS

- A. Noise control curtains - A durable, flexible composite material featuring a noise barrier layer bonded to a sound-absorptive material on one side.
- B. The noise barrier layer - A rugged, impervious material with a surface weight of at least one pound per square foot.
- C. The sound-absorptive material - Include a protective facing, and securely attached to one side of the flexible barrier over its entire surface.
- D. The noise control curtain materials - Abuse resistant, exhibiting superior hanging and tear strength during construction. The curtain barrier material shall have a minimum breaking strength of 120 lb/in. and a minimum tear strength of 30 lb/in. Based on the same test procedures, the curtain absorptive material facing shall have a minimum breaking strength of 100 lb/in. and a minimum tear strength of seven lb/in.
- E. The noise control curtain materials - Corrosion resistant to most acids, mild alkalies, road salts, oils and grease.
- F. The noise control curtain materials - Fire retardant, and approved by the City of Seattle Fire Department before procurement.
- G. The sound-absorptive material - Mildew resistant, vermin proof and nonhygroscopic.
- H. The noise control curtain - STC rating of STC-25 or greater, based on certified sound transmission loss data taken according to ASTM Test Method E90.
- I. The noise control curtain - NRC rating of NRC 0.70 or greater, based on certified sound absorption coefficient data taken according to ASTM C423.
- J. Construct gates and doors of a material with a STC - 25 or greater rating.
- K. Construction Details
  1. Install the noise control curtains in vertical segments extending the full curtain height, and have seams and joints with a minimum overlap of two inches and be sealed using hook fasteners or double grommets. Use construction details according to the manufacturer's recommendations.
  2. Secure the curtain at ground level and/or at intermediate points by framework and supports.
  3. Be responsible for the design, detailing and adequacy of framework, supports, ties,

attachment methods and other appurtenances required for the proper installation of the curtain.

4. Prepare and stamp the design and details necessary for the noise control curtain framework and supports using a Professional Engineer licensed in the State of Washington. Submit the design and detailed engineering to the Resident Engineer for review before procurement.

### **PART 3 - EXECUTION**

#### **3.1 NOISE LEVEL LIMITS**

- A. For daytime operations, comply with the noise level limits of the Administrative Code of the City of Seattle (Ordinance 102228), Chapter 25.08, Noise Control, which regulates the noise levels of construction and equipment operations (Section 25.08.425). Any equipment used in the construction of this project should not exceed the maximum permissible sound levels presented in Table 1. The levels should be measured from the real property of another person or at a distance of fifty feet (50') from the equipment, whichever is greater. Levels may be exceeded between the hours of 7:00 a.m. and 10:00 p.m. on weekdays and between the hours of 9:00 a.m. and 10:00 p.m. on weekends by no more than the following dBA's for the following types of equipment:
  1. 25 dBA for equipment on construction sites, including but not limited to crawlers, tractors, dozers, rotary drills and augers, loaders, power shovels, cranes, derricks, graders, off-highway trucks, ditchers, trenchers, compactors, compressors, and pneumatic-powered equipment;
  2. 20 dBA for portable powered equipment used in temporary locations in support of construction activities or used in the maintenance of public facilities, including but not limited to chainsaws, log chippers, lawn and garden maintenance equipment and powered hand tools; or
  3. 15 dBA for powered equipment used in temporary or periodic maintenance or repair of the grounds and appurtenances of residential property, including but not limited to lawnmowers, powered hand-tools, snow-removal equipment and composters.
  4. Sound created by impact types of construction equipment, including but not limited to pavement breakers, pile drivers, jackhammers, sandblasting tools, or other types of equipment or devices which create impulse noise or impact noise or are used as impact equipment, as measured at the property line or 50 feet from the equipment (whichever is greater), may exceed the maximum permissible sound levels described above in any one-hour period between the hours of 8:00 a.m. and 5:00 p.m. on weekdays and 9:00 a.m. and 5:00 p.m. on weekends, but in no event is to exceed the following:
    - Leq = 90 dBA continuously;
    - Leq = 93 dBA for 30 minutes;
    - Leq = 96 dBA for 15 minutes;
    - Leq = 99 dBA for 7 minutes;
    - Leq levels in excess of 99 dBA are prohibited unless authorized by variance.
  5. Operations of impact types of construction equipment or other types of equipment or devices which create impulse noise or impact noise or are used as impact equipment

between the hours of 5:00 p.m. and 8:00 a.m. on weekdays and 5:00 p.m. and 9:00 a.m. on weekends would be subject to the following noise limits:

5:00 p.m. to 10 p.m. – Leq of 5 dBA above the hourly existing noise level with no construction activities or equipment operating and a maximum noise level (Lmax) of 10 dBA over the hourly existing noise level.

10 p.m. to 8 a.m. (weekdays) and 10 p.m. to 9 a.m. (weekends) – noise levels limits described in paragraph 3.1.B and listed in Table 1.

- B. Nighttime operations noise limits for the hours of 10:00 p.m. to 7:00 a.m. Monday through Friday, from 10:00 p.m. Friday to 9:00 a.m. Saturday and Sunday shall not exceed the noise level limits listed in Table 2 at the noise sensitive receptors designated. These noise limits will be confirmed prior to construction. The Contractor will monitor the existing noise levels at each of the three construction sites for a minimum period of one month before construction begins. The location of the monitoring sites will be determined by DCLU. Based on the results of this measured data the nighttime noise level limits will be finalized by DCLU.
- C. The groundborne noise levels within building structures due to muck train, tunnel boring machine and any other underground and tunneling construction activities - Limited to the Lmax noise levels listed in Table 3.
  - 1. Provide isolation of the muck train rail to reduce vibration transmission between the rail and the tunnel invert to meet the ground borne noise levels specified in Table 3.
  - 2. Submit the muck train rail vibration isolation design for Authority acceptance before installation of track.
- D. At the surface of the construction site during night time hours use only equipment that, operating under full load, meets the noise limits specified in Table 4 when measured according to the test procedures used for equipment noise certification as specified in Paragraph 3.4 of this Section.
- E. If the Contractor's existing equipment on-site does not meet nighttime noise emission limits for surface construction activities specified in Table 4 or falls out of compliance, remove the equipment promptly from nighttime service by immediately parking and turning off equipment when it is safe to do so, or take prompt remedial action to comply with these specifications.

### 3.2 NOISE CONTROL PLAN

#### A. Requirements

- 1. Within 15 days of Notice To Proceed (NTP), submit to the Resident Engineer the name, address, and qualifications of the Acoustical Engineer responsible for preparing and overseeing the implementation of the Noise Control Plan.
- 2. The minimum requirements for the Acoustical Engineer - Bachelor of Science Degree or higher degree, from a qualified program in engineering, physics, or architecture offered by an accredited university or college, and five years experience in noise control engineering and construction noise analysis, or current enrollment as a full Member or Board-certified Member in the Institute of Noise Control Engineering. In addition to the basic requirements shown above, the Acoustical Engineer must demonstrate substantial and responsible experience in preparing and implementing construction noise control and monitoring plans on construction projects conducted in an urban setting, calculating construction noise levels, and designing and overseeing the implementation of construction noise abatement measures.

3. Within 45 days of NTP, submit the Noise Control Plan to the Resident Engineer.
4. Noise Control Plan - Include the following for nighttime construction activities that may occur at the surface of the construction site:
  - a. Site Drawing - Prepare a scaled drawing of the construction site indicating the following:
    - 1) Contract name and number
    - 2) Contractor's name
    - 3) Date
    - 4) Scale
    - 5) Direction of North
    - 6) Noise sensitive locations near the construction site
    - 7) Construction equipment locations used during nighttime hours, designated by the code letter used in Column (a) in Part A of the Noise Control Plan Form, Figure 4.
    - 8) Locations of the noise levels calculated for residential, commercial, and industrial areas as specified in Paragraph 3.2 A.4.c.
    - 9) Locations and types of noise abatement measures that may be required to meet codes and regulations as indicated by the calculations as specified in Paragraph 3.2 B.
  - b. Equipment Inventory - Prepare an inventory of equipment used during nighttime hours by providing the following information in the indicated columns of Noise Control Plan Form, Figure 4.
    - 1) Column (a) - Code letter in sketch to indicate position of equipment on site and to identify Certificates of Noise Compliance
    - 2) Column (b) - Appropriate equipment category from Table 4
    - 3) Column (c) - Equipment manufacturer and model, if known at the time of the Plan's preparation
    - 4) Column (d) - Unique identifier (ID), such as registration number, if known at the time of the Plans preparation.
    - 5) Column (e) - Equipment horsepower
    - 6) Column (f) - Noise emission limit from Table 4.
    - 7) Column (g) - Estimated noise level at 50 feet; if greater than the value in Column (f), source noise control device (e.g. mufflers) must be used to comply with limit.
    - 8) Column (h) - Estimated date of first use on site

- 9) Column (i) Estimated date of last use on site.
  - c. Noise Calculations - Prepare calculations of nighttime  $L_{max}$  and one-hour  $L_{eq}$  noise levels expected at the nearest residential property line based on the equipment noise levels given in Part A of the Noise Control Plan Form. Determine the nearest property lines from the currently identified noise-sensitive locations indicated in Table 5. Preliminary one-hour  $L_{eq}$  construction noise projections for this Contract are provided in Table 6. Make the calculations for locations where noise emitted by applicable equipment will cause the greatest noise level for each type of land use, for nighttime periods, if necessary. Provide the results on Part B of the Noise Control Plan Form with calculations included below the results, and with the locations for the calculations indicated on the site sketch.
  - d. Description of Required Noise Abatement Measures as specified in Paragraph 3.2 C. of this Section.
5. Update the Noise Control Plan at three month intervals (based on the Resident Engineer's initial acceptance date) and re-submit the Plan within 10 days of the start of each quarterly period. Update and re-submit the Noise Control Plan upon any major change in work schedule, construction methods, or equipment operations not included in the most recent Plan.
- B. Noise Abatement Measures - If the results of the noise calculations prepared in accordance with Paragraph 3.2 A.4.c. indicate that noise level limits listed under Paragraph 3.1 will be exceeded, identify proposed noise abatement measures, their anticipated effects (dBA reductions), and a schedule for their implementation. Re-calculate the noise levels at the nearest sensitive receptor location property lines that include the anticipated noise reduction effects and submit the results on Part B of the Noise Control Plan Form. Include, as backup documentation to Part B of the Noise Control Plan, drawings, sketches, and suitable calculations that demonstrate anticipated noise reduction benefits and that proposed structures or facilities comply with applicable building code requirements.
  - C. Noise Reduction Methods - To the extent required to meet the noise limits specified by this Section, use reasonable efforts to include noise reduction measures listed below to minimize construction noise emission levels. Noise reduction measures - Include, but not be limited to the following:
    1. Scheduling truck loading, unloading, and hauling operations so as to minimize noise impact near noise sensitive locations and surrounding communities.
    2. Locating stationary equipment so as to minimize noise impact on the community.
    3. Do not leave equipment pieces idling when not in use.
    4. Limiting the use of enunciators or public address systems, except for emergency notifications.
    5. Maintaining equipment such that parts of vehicles and loads are secure against rattling and banging.
    6. Limit the time that steel decking or plates for street decking or covering excavated areas are in use.
    7. Grading of surfaced irregularities on construction sites to prevent the generation of impact

noise and ground vibrations by passing vehicles.

8. Schedule Work to avoid simultaneous activities that both generate high noise levels.

### 3.3 NOISE MONITORING PLAN

#### A. Requirements

1. Have the Noise Monitoring Plan prepared and administered by the Contractor's Acoustical Engineer.
2. Within 45 days of NTP, submit the Noise Monitoring Plan to the Resident Engineer, specifying the nighttime construction activities, monitoring locations, equipment, procedures, schedule of measurements and reporting methods to be used.
3. Monitor the existing noise levels at each of the three construction sites for a minimum period of one month before construction begins. The location of the monitoring sites to be determined by DCLU.
4. Furnish noise monitoring data to the Resident Engineer on a weekly basis. Include measurements taken during the previous week.
5. In the event that the measured noise levels exceed allowable limits, immediately notify the Resident Engineer and immediately implement additional Noise Abatement Measures as specified in the Noise Control Plan.
6. If the measured nighttime levels exceed the noise limits specified in this Section, reduce the noise levels by appropriate abatement measures in order to comply with the nighttime Noise Variance requirements or terminate the nighttime construction activity responsible for the noise limits exceedance until the daytime hours when higher noise levels are permitted.

#### B. Measurement Locations

1. Measure the following noise-sensitive locations in the vicinity of each construction site for noise levels. These locations may change during the Contract and shall be updated as required by the Authority.

##### West Portal Construction Site

Site WP 1: 2917 12<sup>th</sup> Avenue at Seaview Park

##### Beacon Hill Station Construction Site

Site BH 1: El Centro: Jose Marti Child Development Center

Site BH 2: 2608 17<sup>th</sup> Avenue

Site BH 3: 2702 17<sup>th</sup> Avenue

Site BH 4: 2802 17<sup>th</sup> Avenue

Site BH 5: 2820 17<sup>th</sup> Avenue

Site BH 6: Laura Apartments, 2610 16<sup>th</sup> Avenue

Site BH 7: 2817 16<sup>th</sup> Avenue

Site BH 8: 2801 16<sup>th</sup> Avenue

Site BH 9: Lander Apartments, 2541 15<sup>th</sup> Avenue

Site BH 10: 2538 Beacon Avenue

East Portal Construction Site

Site EP 1: 3029 25<sup>th</sup> Avenue

Site EP 2: 2721 25th Avenue

Site EP 3: Mt. Baker Apartments, 2569 29<sup>th</sup> Avenue

Site EP 4: 2905 McClellan Street

Site EP 5: 2825 29<sup>th</sup> Avenue

2. Prepare and submit a scaled plan indicating monitoring locations, including measurements to be taken at construction site boundaries and at nearby residential property lines.
- C. Provide the Authority with two (2) sound level meters that meets the requirements of Paragraph 3.3 D, Measurement Equipment,. of this Section.
- D. Measurement Equipment
1. Perform noise measurements with an instrument that is in compliance with the criteria for a Type 1 (Precision) or Type 2 (General Purpose) Sound Level Meter as defined in the current revision of ANSI Standard S1.4.
  2. Provide sound level meters capable of measuring the  $L_{max}$  and one-hour  $L_{eq}$  on the A-Weighted scale required by regulatory criteria and Noise Level Limits.
  3. Calibrate sound level meters, microphones, and calibrators for certified laboratory conformance at least once a year. Submit a current certificate of conformance to the Resident Engineer before using the sound level meter and submit updated certificates following subsequent calibrations on a yearly basis for the duration of this Contract or upon the completion of repairs to the instrument.
- E. Measurement Procedure
1. Field calibrate the sound level meter using an acoustic calibrator, according to the manufacturer's specifications, before each measurement.
  2. Except as otherwise indicated, perform measurements using the A-weighting network and the SLOW response of the sound level meter.
  3. Measure impulsive or impact noises using the A-Weighting network and the FAST response of the sound level meter.
  4. Fit the measurement microphone with an appropriate windscreen at the location of the sensitive receptor at least four to six feet away from the nearest reflective surface.
  5. Take noise measurements at noise sensitive locations within 150 feet of the construction site at least once each week and after a change in construction activity or construction location. Measurement periods – a minimum of 20 minutes.
  6. Construction noise measurements shall coincide with daytime and nighttime periods of maximum noise-generating construction activity, and be taken during the construction phase or activity that has the greatest potential to create annoyance or to exceed

applicable noise regulations and restrictions.

7. If, in the estimation of the person performing the measurements, outside noise sources contribute significantly to the measured noise level, repeat the measurements (with the same outside source contributions when construction is inactive to determine the background noise level.
8. Submit noise data to the Resident Engineer on a weekly basis using the Noise Measurements Report Form provided in Figure 2. Note the type of measurement (e.g. baseline, on-going construction, etc.) on the form.
9. Clearly identify monitoring locations and sketch on the back of the Noise Measurements Report Form, Figure 2, along with the locations of and distances from any noise-sensitive location.
10. Identify construction equipment operating during the monitoring period and the locations sketched on the back of the Noise Measurements Report Form, along with the locations and distances to any noise sensitive location.

### 3.4 EQUIPMENT NOISE CERTIFICATION

#### A. Requirements for Construction Equipment

1. Ensure that Contractor and Subcontractor equipment, of the types listed in Table 4 to be used (during nighttime hours at the surface of the construction site) for a total duration greater than five days, shall be tested for compliance with the stated noise emission limits by the Acoustical Engineer during the first day of use on the construction site or at an alternative site acceptable to the Resident Engineer.
2. Retest equipment as described above at six month intervals while in use on-site, and certify new equipment before being placed into service at the site.
3. For each piece of equipment tested, submit a noise report to the Resident Engineer by completing the Application for Certificate of Equipment Noise Compliance provided in Figure 3. Ensure that the equipment identification number used for the Certificates is consistent with the identification number used in the Noise Control Plan.
4. Do not use equipment of the types listed in Table 4, as described above on-site without valid certificates of noise compliance submitted as required.

#### B. Test Procedures for Construction Equipment

1. Operate engine-powered equipment by the Contractor or Contractor's representative at maximum governed rpm under full load conditions during the tests under the supervision of the Acoustical Engineer.
2. Test portable and mounted impact hammers, such as hoe rams and jackhammers to be used for concrete breaking, by the Acoustical Engineer during the first day of actual operation at the construction site under maximum load conditions as rated by the equipment manufacturer.
3. Noise certification measurements – As specified in Paragraph 3.3 F. of this Section. Use an acoustic calibrator of the type recommended by the sound level meter manufacturer before measurements.
4. If possible, make measurements at two locations, from the right and left sides of the



equipment casing, at a distance of 50 feet and a height of five feet above ground level, with the equipment operating as indicated in items 1, 2, or 3 above for a minimum period of one minute. Reduce measurements made at less than 50 feet, because of space limitations at the test site by the values given in Table 7 to estimate the 50-foot sound level.

C. Compliance

1. Submit a noise report to the Resident Engineer for each item of equipment used on the surface of the construction site during nighttime hours of the types listed in Table 4. Submit the report on the form shown in Figure 3 with certification by the Acoustical Engineer that equipment noise emissions do not exceed those prescribed in Table 3.
2. If the noise levels obtained during the tests exceed those specified in Table 4, remove such equipment from nighttime use until such equipment is modified and retested, or substitute other equipment to meet the noise level requirements.
3. Upon compliance the Resident Engineer will mark the noise report indicating the Resident Engineer's concurrence, including the certification date and equipment identification number, for verification by Resident Engineer. Keep the noise reports readily available on file in the construction field office for inspection by the Resident Engineer upon request.
4. The Certificate of Noise Compliance will remain valid for a period of six months only. Delays caused by the certification refusal or by time lost in improving the rejected equipment or finding alternate acceptable equipment will not be a basis for monetary or time delay claims or for avoidance of liquidated damages.
5. Equipment shall be subject to spot noise level testing by the Resident Engineer's discretion to determine that the equipment in use meets the requirements specified in Table 4. If the Resident Engineer requests such tests, locate and operate the equipment as directed by the Resident Engineer at the designated site so as to facilitate the measurements. Provide the Resident Engineer with a copy of the results of the measurements. If such tests demonstrate that any equipment does not comply with this Section, its Certificate of Noise Compliance will be revoked and equipment taken out of use until compliance is achieved. A new Certificate of Noise Compliance will be issued upon proof of compliance.

3.5 VIBRATION LEVEL LIMITS

- A. Measures applied to limit noise levels may in some cases limit vibration levels also. Measures specified above for noise levels are applicable.
- B. All Areas – Conduct Construction activities so that vibration levels at a distance of 50 feet from construction limits or at nearest affected building (whichever is closer) do not exceed root-mean-square (rms.) unweighted vibration velocity levels in vertical direction over a frequency range of 1 to 100 Hz as listed in Table 8.
- C. Vibration levels at buildings affected by construction operations refer to vertical direction vibration on ground surface or building floor, or 50 feet from Construction Limits, whichever is closer.
- D. Conduct daily measurements of vibration during peak vibration generating construction activities.

### 3.6 CONSTRUCTION SITE NOISE CONTROL

#### A. Perimeter Noise Barrier Fence

1. Construct a perimeter noise barrier fence in accordance with Paragraph 2.2, Noise Barrier Fences at the perimeter of each construction site as indicated. The use of noise barrier fences is a minimum noise control requirement that may not provide sufficient noise reduction to meet the daytime or nighttime noise limits specified in this Section. It is the Contractor's responsibility to meet these limits by other methods such as raising the height of the noise barrier fences and providing additional noise control measures specified in Paragraphs 3.8 and 3.9, as indicated.
2. Construct gates and/or doors in the fence either hinged or rolling of the same or equally effective material as the noise barrier fence. Construct gates and doors in the fence to ensure that the edges overlap the fence to eliminate gaps. During nighttime hours maintain gates and doors in a closed position except for brief periods of time to allow access to the Construction Site.

#### B. Noise Barrier Fences

1. Attach lagging to support posts designed so that the fence will withstand 80 mph wind loads plus a 30 percent gust factor.
2. Provide flush mating surfaces of wall sides when walls are joined together or at corners. Close gaps between wall sections and between bottom edge of walls and grade with material that will completely close the gaps and be dense enough to attenuate noise.
3. Minimum height of noise barrier fence – As indicated.
4. Be responsible for the design, detailing and adequacy of the framework and supports, posts, attachment methods and other appurtenances required for the proper erection of the noise control walls.
5. Prepare the design details for the noise control wall footing, steel posts, supports and framework and have stamped using a Professional Engineer licensed in the State of Washington. Submit the design and detailed engineering to the Resident Engineer.

- C. All haul trucks that remove spoils from the construction sites should have their beds and walls, lined with sound-deadening material to minimize the impact sounds of the excavated materials falling onto to the hard metal surfaces of the truck bed.
- D. During nighttime construction activities shield noise generating equipment to the extent that the line-of-sight is broken between the equipment's engine exhaust stack and/or engine casing and any residential building or structure where sleep activity occurs within 500 feet of that activity.
- E. In no case expose public to construction noise levels exceeding 90 dBA (slow), or to impulsive noise levels with a peak sound pressure level exceeding 115 dBC maximum transient level as measured on general purpose sound level meter on C-weighting and fast meter response.

### 3.7 CONSTRUCTION METHODS – EQUIPMENT

- A. Minimize the use of impact devices, such as jackhammers, pavement breakers, and hoe rams. Where possible, use concrete crushers or pavement saws rather than hoe rams for tasks such as concrete deck removal and retaining wall demolition.

- B. Pneumatic impact tools and equipment used at the construction site shall have intake and exhaust mufflers recommended by the manufacturers thereof, to meet relevant noise ordinance limitations.
- C. Equip noise producing equipment i.e. jackhammers and pavement breaker(s) with acoustically attenuating shields or shrouds recommended by the manufacturers thereof, to meet relevant noise ordinance limitations.
- D. Line or cover hoppers, conveyor transfer points, storage bins, and chutes with sound-deadening material.
- E. Provide mufflers or shield paneling for other equipment, including internal combustion engines, recommended by manufacturers thereof.
- F. Blasting and Impact Pile Driving is specifically prohibited from use.
- G. As required to meet the noise limits specified in this Section, use alternative procedures of construction and selection of proper combination of techniques that generate least overall noise and vibration. Such alternative procedures include the following:
  - 1. Use electric welders powered from utility main lines instead of riveting or electric generators/welders.
  - 2. Mix concrete off-site instead of on-site.
  - 3. Employ prefabricated structures instead of assembling on-site.
- H. Use construction equipment manufactured or modified to dampen noise and vibration emissions, such as:
  - 1. Use electric instead of diesel-powered equipment.
  - 2. Use hydraulic tools instead of pneumatic impact tools.
  - 3. Use electric instead of air- or gasoline-driven saws.

### 3.8 CONSTRUCTION METHODS – OPERATIONS

- A. Operate equipment so as to minimize banging, clattering, buzzing, and other annoying types of noises, especially near residential areas during the nighttime hours.
- B. To the extent feasible, configure the construction site in a manner that keeps noisier equipment and activities as far as possible from noise sensitive locations and nearby buildings.
- C. All back-up alarms will be switched to strobe warning lights and/or signal persons between the hours of 10 p.m. and 7 a.m. on weekdays and 9:00 a.m. on weekends.
- D. In no case shall the above restrictions limit the Contractor's responsibility for compliance with applicable Federal, state and local safety ordinances and regulations and other Sections of these construction specifications.
- E. Maximize physical separation, as far as practicable, between noise generators and noise receptors. Separation includes following measures:
  - 1. Provide enclosures for stationary items of equipment and barriers around particularly noisy areas on site.

2. Locate stationary equipment to minimize noise and vibration impact on community, subject to acceptance of the Resident Engineer.
- F. Minimize noise-intrusive impacts during most noise sensitive hours.
1. Plan noisier operations during times of highest ambient noise levels.
  2. Keep noise levels relatively uniform; avoid excessive and impulse noises.
  3. Turn off idling equipment.
  4. Phase in start-up and shutdown of site equipment.
- G. Select truck routes for muck disposal so that noise from heavy-duty trucks will have minimal impact on sensitive land uses (e.g., residential) and submit to the ( ) for approval.
1. Conduct truck loading, unloading and hauling operations so noise and vibration are kept to a minimum.
  2. Route construction equipment and vehicles carrying soil, concrete or other materials over streets and routes that will cause least disturbance to residents in vicinity of Work.
  3. Do not operate trucks on streets that pass by schools during school hours.
  4. Submit haul routes and staging areas to the City of Seattle DOT, 30 days before required date.

### 3.9 CONSTRUCTION METHODS – MOVEABLE NOISE BARRIERS

- A. Install moveable noise barriers in accordance with Paragraph 2.3, Moveable Noise Barriers, in locations not specified in the Noise Control Plan adjacent to equipment as required to meet the noise limits specified in this Section, to shield the public from construction noise during the course of the Contract.
- B. Provide readily removable moveable noise barriers so that they may be repositioned, as necessary, to provide noise abatement for non-stationary and stationary processes.
- C. Installation, Maintenance, and Removal
1. Install the barriers such that the sound-absorptive surfaces face the noise source.
  2. Maintain the moveable noise barriers and repair damage that occurs, including, but not limited to, keeping barriers clean and free from graffiti, and maintaining structural integrity. Promptly repair or replace gaps, holes, and weaknesses in the barriers, and openings between, or under the units with new material.

### 3.10 CONSTRUCTION METHODS – NOISE CONTROL CURTAINS

- A. Install noise control curtains in accordance with Paragraph 2.4, Noise Control Curtains, in locations not specified in the Noise Control Plan adjacent to equipment as required to meet the noise limits specified in this Section, to shield the public from construction noise during the course of the Contract.
- B. The noise control curtains shall be readily moveable so that they may be repositioned, as necessary, to provide noise abatement for non-stationary and stationary processes.

C. Installation, Maintenance and Removal

1. The noise control curtains shall be installed without any gaps such that the sound—absorptive side faces the construction activity to be shielded.
2. Maintain the noise control curtains and promptly repair any damage that may occur. Gaps, holes or weaknesses in the curtain, or openings between the curtain and the ground shall be promptly repaired by the Contractor.

**TABLE 1 SEATTLE NOISE ORDINANCE MAXIMUM PERMISSIBLE SOUND LEVELS**

District of Sound Source	District of Receiving Property Within the City of Seattle		
	Residential (dBA)	Commercial (dBA)	Industrial (dBA)
Rural	52	55	57
Residential	55	57	60
Commercial	57	60	65
Industrial	60	65	70

**TABLE 2 MAXIMUM PERMISSIBLE NIGHTTIME CONSTRUCTION NOISE LEVEL LIMITS**

Site	Location	Average Existing Nighttime Noise Levels (12 am – 5 am)	Construction Noise Level Limit
<b>West Portal Construction Site</b>			
WP 1	2917 12 <sup>th</sup> Avenue at Seaview Park	64 dBA	68 dBA
<b>Beacon Hill Station Construction Site</b>			
BH 1	El Centro - Jose Marti Child Development Center	56 dBA	61 dBA
BH 2	2608 17 <sup>th</sup> Avenue	58 dBA	64 dBA
BH 3	2702 17 <sup>th</sup> Avenue	60 dBA	
BH 4	2802 17 <sup>th</sup> Avenue	60 dBA	
BH 5	2820 17 <sup>th</sup> Avenue	61 dBA	
BH 6	Laura Apartments, 2610 16 <sup>th</sup> Avenue	60 dBA	65 dBA
BH 7	2817 16 <sup>th</sup> Avenue	56 dBA	61 dBA
BH 8	2801 16 <sup>th</sup> Avenue	57 dBA	62 dBA
BH 9	Lander Apartments, 2541 15 <sup>th</sup> Avenue	59 dBA	64 dBA
BH 10	2538 Beacon Avenue	60 dBA	65 dBA
<b>East Portal Construction Site</b>			
EP 1	3029 25 <sup>th</sup> Avenue	50 dBA	55 dBA
EP 2	2920 25 <sup>th</sup> Avenue	50 dBA	55 dBA
EP 3	Mt. Baker Apartments, 2569 29 <sup>th</sup> Avenue	68 dBA	71 dBA
EP 4	2905 McClellan Street	58 dBA	63 dBA
EP 5	2825 29 <sup>th</sup> Avenue	50 dBA	55 dBA

**TABLE 3 ALLOWABLE MAXIMUM INTERIOR GROUND-BORNE NOISE FROM UNDERGROUND CONSTRUCTION ACTIVITIES  $L_{max}$**

<u>Community Area Category</u>	<u>Single Family Dwellings</u>	<u>Multi-Family Dwellings</u>	<u>Hotel/Motel Buildings</u>
Residential	40 dBA	45 dBA	50 dBA
Commercial	45 dBA	50 dBA	50 dBA
<u>Type of Building or Room</u>			
Concert Halls, Recording and TV Studios		30 dBA	
Auditoriums and Music Rooms		35 dBA	
Churches and Theaters		40 dBA	
Hospital Sleeping Rooms		45 dBA	
Courtrooms		40 dBA	
Schools and Libraries		45 dBA	
Offices		50 dBA	
Commercial Buildings		55 dBA	

**Note:** Maximum groundborne noise are as measured in the inside of the affected noise sensitive structure.

**TABLE 4. NOISE EMISSION LIMITS FOR CONSTRUCTION EQUIPMENT USED DURING NIGHTTIME HOURS; MEASURED AT 50 Feet FROM CONSTRUCTION EQUIPMENT\***

<u>Equipment Category</u>	<u>Lmax Level (dBA)</u>
Backhoe	75
Bar Bender	75
Chain Saw	81
Compactor	75
Compressor**	65
Compressor (other)	75
Concrete Mixer	71
Concrete Pump	77
Crane	81
Dozer	81
Front End Loader	75
Generator	77
Gradall	81
Grader	81
Paver	81
Pneumatic Tools	81
Scraper	81
Tractor	79

\* Noise emission limits apply to equipment used at surface of the construction site during nighttime hours of 10 p.m. to 7 a.m..

\*\* Portable Air Compressor that is rated at 75 cfm or greater and that operates at greater than 50 psi

**TABLE 5. NOISE SENSITIVE LOCATIONS** (See Drawing(s) \_\_\_\_\_)

<b>Location No.</b>	<b>Address</b>	<b>Land Use</b>



**TABLE 6. PRELIMINARY NOISE PROJECTIONS** (See Drawing (s))

Activity	Construction One-Hour $L_{eq}$ at Each Receiver (dBA)			
	Receiver #1	Receiver #2	Receiver #3	Receiver #4

**TABLE 7. ADJUSTMENTS FOR CLOSE-IN EQUIPMENT NOISE MEASUREMENTS**

<u>Distance (Feet)</u>	<u>Measurement Values to be Subtracted from Measured Sound Level to Estimate Sound Level at 50 Feet (dBA)</u>
19-21	8
22-23	7
24-26	6
27-29	5
30-33	4
34-37	3
38-42	2
43-47	1
48-50	0

**TABLE 8. CONSTRUCTION VIBRATION LIMITS**

<u>VIBRATION TYPE AND PERMISSIBLE AGGREGATE DURATION</u>	<u>LIMIT</u>
Sustained ( 1 hr/day)	0.01 in/sec (80 VdB re $10^{-6}$ in/sec)
Transient (<1 hr/day)	0.03 in/sec (90 VdB re $10^{-6}$ in/sec)
Transient (<10 min/day)	0.10 in/sec (100 VdB re $10^{-6}$ in/sec)

**QUARTERLY NOISE CONTROL PLAN (DUPLICATE AS NEEDED)**

Contract No.: \_\_\_\_\_ Contract Name:

Contractor: \_\_\_\_\_ Site:

Date: \_\_\_\_\_ Land Use:

Resubmit every 3 months.

**PART B: RESIDENTIAL, AND COMMERCIAL PROPERTY NOISE LEVELS**

	Calculated Noise Levels (dBA)*	
	Calculated one hour $L_{eq}$ (dBA)	Calculated $L_{max}$ (dBA)
Nighttime		

**NOISE ABATEMENT MEASURES**

**ANTICIPATED EFFECTS**

CALCULATIONS - attach additional sheet(s) as needed.

\* see Paragraph 3.2 A.4.c.

FIGURE 1. QUARTERLY NOISE CONTROL PLAN FORM - PART B

Contract No(s):

Date:

Time:

## NOISE MEASUREMENTS REPORT FORM

Measured By: \_\_\_\_\_ Of: \_\_\_\_\_ (Company)

Monitoring Address: \_\_\_\_\_ (Provide Sketch on Back)

Location No: \_\_\_\_\_ Wind Speed: \_\_\_\_\_ Km/Hr Direction: \_\_\_\_\_  
(MPH x 1.6)

Location of Sound Level Meter: (No closer than 15 meters from equipment and 3 meters from building)

Monitoring was Conducted: \_\_\_\_\_ Meters from Equipment (\_\_\_\_\_)  
(Type(s): Leave Blank for Baseline)

Land Use: ☐ Residential/Institutional ☐ Business/Recreational ☐ Industrial

Sound Level Meter: Make and Model: \_\_\_\_\_ ☐ A - Weighted Sound Level (Slow)

Duration of Measurement: (15 minutes to 1 hour)

Calibration	
One-Hour Leq	
L50	
L10	
L1	
LMAX	
Allowable Noise Limit      Leq	
Lmax	

Field Notes;

Check one of the following:

☐ Ongoing Construction

☐ Post-Construction: \_\_\_\_\_  
(Contract)

☐ Baseline Conditions

(Complete all that apply below)

Active Contract(s): \_\_\_\_\_  
(List all contracts that contribute to measured noise)

Complaint Response: \_\_\_\_\_  
(Describe: Include Log-In Number)

Abatement Follow-Up: \_\_\_\_\_  
(Describe)

FIGURE 2: NOISE MEASUREMENTS REPORT FORM

## APPLICATION FOR CERTIFICATE OF EQUIPMENT NOISE COMPLIANCE

Contractor Name:

Contract Name & Number:

Equipment Type:

Manufacturer & Model Number:

Identification Number:

Rated Power & Capacity:

Operating Condition During Test:

### Measured Sound Levels at 20 to 50 feet:

#### Measured Values and Distance:

Right Side: \_\_\_\_\_ dBA (SLOW), at \_\_\_\_\_ feet

Left Side: \_\_\_\_\_ dBA (SLOW), at \_\_\_\_\_ feet

#### Estimated Values at 50-Foot Distance:

Right Side: \_\_\_\_\_ dBA (SLOW).

Left Side: \_\_\_\_\_ dBA (SLOW).

Maximum Values Allowed for this Equipment: \_\_\_\_\_ dBA (SLOW) at 50 feet

If equipment sound level exceeds maximum value allowed, indicate action taken to achieve compliance:

Name, Address & Phone no.  
of Acoustical Engineer

Authorized Signature: \_\_\_\_\_ Date:

CONTRACTOR'S APPROVAL:

Authorized Signature: \_\_\_\_\_ Date:

ENGINEER'S CONCURRENCE:

Authorized Signature: \_\_\_\_\_ Date:

FIGURE 3. EQUIPMENT SOUND LEVEL DATA REPORTING FORM

Contract No.: \_\_\_\_\_ Contract Name: \_\_\_\_\_ Contractor: \_\_\_\_\_  
Site: \_\_\_\_\_ Date: \_\_\_\_\_ Resubmit every three months

## PART A: EQUIPMENT INVENTORY

[illegible]

Page B-25